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(TOLL FREE OUTSIDE INDIANA)
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Serial No. _____

INSTRUCTION MANUAL

MODEL 1405

SWEEP GENERATOR

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1.1 INTRODUCTION

The Wavetek Model 1405 is an all-solid-state electronically swept and tuned VHF Sweep/Marker Generator covering the 1 to 500 MHz range. It is designed for the testing and aligning of VHF television tuners and receivers and of CATV converters and headend equipment.

Center frequency is selected via a programmer which also adds audio and video carrier markers. The markers consist of sharp negative differentiated pules internally added to the demodulated envelope. The programmer enables the sweep generator to be sequenced through a test procedure with pushbutton switches (or a convenient dual-function remote foot switch) instead of manual tuning and adjustment. Up to 8 different programmer sequences of up to 99 frequencies each may be selected.

One of the Model 1405's most useful options is that of automatic level operation. Simply stated, in automatic level operation, the sweep generator RF output level is automatically adjusted to follow the variations of the tuner or receiver to maintain a constant one volt pattern on the oscilloscope display. A baseline pedestal in the display indicates the RF output level. This provides considerable time saving during the alignment procedure. Ths option includes a differentiated pulse that provides a center frequency indication directly on the oscilloscope.

Another option provides up to five additional markers when IF is selected. These are sharp, positivegoing or negative-going pulses available at the rear panel, and/or negative differentiated pulses internally added to the demodulated envelope, and are derived from plug-in-crystal filters.

Other options include local oscillator tracking markers and convertor baseline leading oscillator tracking markers.

All optional features, as well as the circuits for the basic sweep generator, have plug-in modular construction. This allows optional features to be factory-installed at the time of purchase or customer installed at a later date. This concept offers protection against obsolescence, since updated and additional features can be simply and economically added as new tuner designs and test procedures dictate.

Maintenance problems can also be greatly simplified by the stocking of several modules instead of hundreds of discrete parts. Servicing time of a defective instrument can then be cut to a fraction of the time otherwise required, and service can be performed by relatively inexperienced technicians.

1.2 SPECIFICATIONS

FREQUENCY	
Programmer Operation	Up to 8 sequences of up to 99 channels each (specified by customer). Each channel frequency may be any multiple of 0.25 MHz between 1 and 500 MHz. The specific center frequency of each band is (audio carrier + video carrier)/2. The total number of discrete frequencies specified may not exceed 240.
Manual Operation	Center frequency continuously variable from 1 to 500 MHz.
SWEEP WIDTH	
Programmer and Manual Operation	2 ranges; less than 1 to greater than 50 MHz and less than 1 to greater than 500 MHz.
Remote Operation	Less than 1 to greater than 500 MHz.
SWEEP RATE	AC line frequency (50 to 60 Hz).
BLANKING	RF output shut off during sweep retrace to provide a zero level baseline.
CONNECTOR	BNC
IMPEDANCE	75 ohms
AMPLITUDE	+57 dBmV (0.708 VRMS) to +2 dBmV (1.26 mVRMS)
FLATNESS	$\pm$0.25 dB (measured with Wavetek Model D171 RF Detector.
DISPLAY LINEARITY	$\pm$2%
SCOPE HORIZONTAL OUTPUT	16 Vpp triangle waveform.
ATTENUATION	
RANGE	
Vernier	0 to 20 dB continuous
Step	0 to 35 dB in 5 dB steps
ACCURACY (Step)	+0.5 dB over full frequency range.
REMOTE PROGRAMMING	Rear-panel REMOTE jack provides connections for remote control of center frequency, sweep width, and the 0 to 20 dB VERNIER ATTENUATOR.

PULSE MARKERS	Pulse-type, crystal-controlled at 2.25 MHz above and below selected channel frequency (typically video and audio carrier frequencies). NOTE: Marker frequencies for Options A-71, A-73, and B are specified by the customer.
Amplitude	0 to approximately 8 Vpp at front-panel SCOPE VERT OUT connector. 0 to approximately 30 V (switchable polarity) at rear-panel PULSE MARKER OUTPUT connector.
Width	Approximately 1% of horizontal display.
Accuracy	±0.02% (+25 kHz - 0 Hz) measured from leading edge.
Presentation	Differentiated pulses from front-panel SCOPE VERT OUT connector.
BIRDY MARKERS (FOR USE WITH OPTION B-5)	Birdy by-pass, crystal-controlled at customer-specified frequency.
Accuracy	± 0.005%
Width	Approximately 400 kHz
Size	Adjustable from approximately 3 mVPP to 3 Vpp
External	Optional rear-panel connector accepts external CW signal for conversion to birdy marker. Input level = 100 mVRMS into 50 ohms.
GENERAL	
Power Requirements	115/230 VAC; ±10%; 50/60 Hz. Approximately 20 W.
Dimensions	22.9 cm (9 in) high x 21.0 cm (8-1/4 in) wide x 34.9 cm (13-3/4 in) deep
Weight	11.5 kg (25.3 lb)

1.3 OPTIONS

OPTION A-71	Up to five extra pulse markers at customer-specified IF frequencies may be added to the instrument. These markers are controlled by the front-panel IF MARKER pushbutton switch.
OPTION A-73	A second pair of pulse markers at customer-specified frequencies may be added. These markers appear on each channel in addition to the normal channel markers.

OPTION B	Local Oscillator Tracking generates two pulse markers based on the IF output frequency from a tuner. These markers indicate RF bandwidth, local oscillator frequency, and tracking. The markers can be any two frequencies within the IF input frequency range. With the addition of a capacitor, a channel-center pulse can be added, if desired.
IF INPUT	
Frequency	28 to 47 MHz
Minimum Level	Approximately 1 mV at IF IN connector (Zin = 50 ohms).
OPTION B-5	Converter Baseline Local Oscillator Tracking Markers provides a UHF sweep signal which appears on the retrace portion of the demodulated response. An internal crystal-controlled or external birdy marker is generated at the proper converter 2nd L.O. frequency, and also appears on the retrace along with a birdy marker generated at the actual converter 2nd L.O. frequency. When the converter is properly aligned, the two birdy markers will coincide. Option B-5 requires Option A-1 (Single Frequency Birdy Marker at specified frequency) or SP617 (External Birdy Marker). Up to 3 birdy markers may be installed.
OPTION C	Automatic Level Control And Scope Indicators provides automatic adjustment of the 0 to 20 dB VERNIER ATTENUATOR to correct for variations in the gain of the tuner under test. Also provided are visual indications of the instrument's center frequency and RF output level.
OPTION D	A 70 dB (10 dB/step) Step Attenuator is available to replace the standard 35 dB (5 dB/step) Step Attenuator to provide greater RF output level range.
OPTION I	CONVERTER INTERFACE box (including cables) provides the necessary interconnections between the 1405 and converter under test. This simplifies the test equipment setup and insures repeatable measurements.
SP221	An auxiliary "outrigger" chassis is mounted on top of the Model 1405 programmer section to provide 12 crystal controlled CW sources at the video carrier frequencies of channels 2 through 13. The CW sources are selected by front-panel pushbutton switches.

SP426	A single crystal-controlled CW source at a customer-specified frequency is added to the instrument and activated by one of the front-panel CW source pushbuttons. One or two SP426 sources can be installed in the instrument.

1.4 ACCESSORIES

Furnished with instrument	Instruction manual.
	Spare plug and pins to mate with rear-panel REMOTE jack.
Available at extra cost	RF Detector: Model D171, 75 ohms; Model D151, 50 ohms.
	Module Service Kit (K102) contains module extender and extension cables.
	Rack Mount Kit (K103) enables mounting of instrument in a standard 19 inch instrument rack.

2.1 INTRODUCTION

This section provides complete installation and operating instructions for the Wavetek Model 1405. The instructions include information on the mechanical installation, electrical installation, front-and-rear-panel features, and operating procedures.

2.2 MECHANICAL INSTALLATION

2.2.1 INITIAL INSPECTION

After unpacking the instrument, visually inspect external parts for damage to knobs, connectors, surface areas, etc. The shipping container and packing material should be saved in case it is necessary to reship the unit.

2.2.2 DAMAGE CLAIMS

If the instrument received has been damaged in transit, notify the carrier and either the nearest Wavetek area representative or the factory in Indiana. Retain the shipping carton and packing material for the carrier's inspection. The local representative or the factory will immediately arrange for either replacement or repair of your instrument without waiting for damage claim settlements.

2.2.3 RACK MOUNTING USING K103

Contents (See Figure 2-1).

ITEM	QTY	PART NO.
A (Side)	1 ea.	1410-00-4360
B (Side)	1 ea.	1410-00-5010
C (Screw)	8 ea.	2810-17-8106

PROCEDURE

Remove the screws from one side panel. Mount item A or B against the side panel of the instrument and secure with the screws provided. Repeat for the other side of unit. Items A and B may be interchanged to position the instrument on the desired side of the instrument rack.

2.3 ELECTRICAL INSTALLATION

The Wavetek Model 1405 can operate from either 115 VAC or 230 VAC supply mains. The rear-panel AC LINE SWITCH selects which of these operating voltages is being used, and adjusts the Power Supply accordingly. The Power Supply is designed to operate at an AC supply frequency of 50 or 60 Hz.

Instruments are shipped from the factory set up for 115 VAC operation unless otherwise specified.

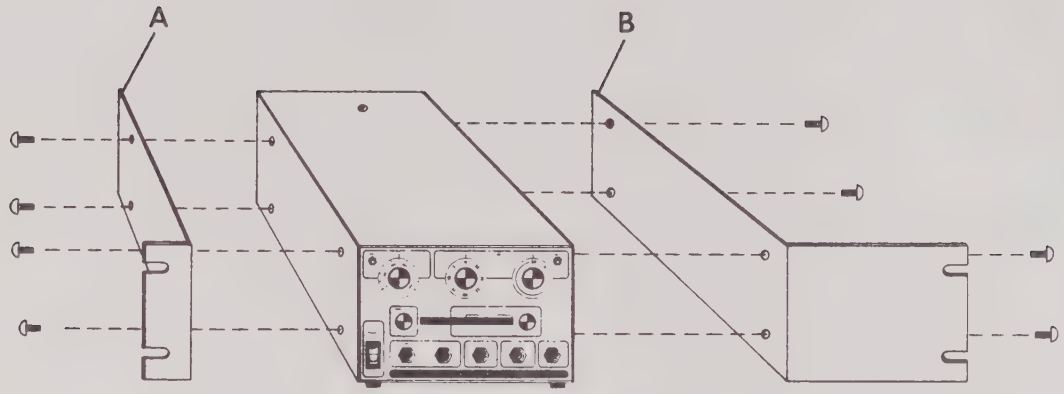


Figure 2-1. K103 Rack Mounting

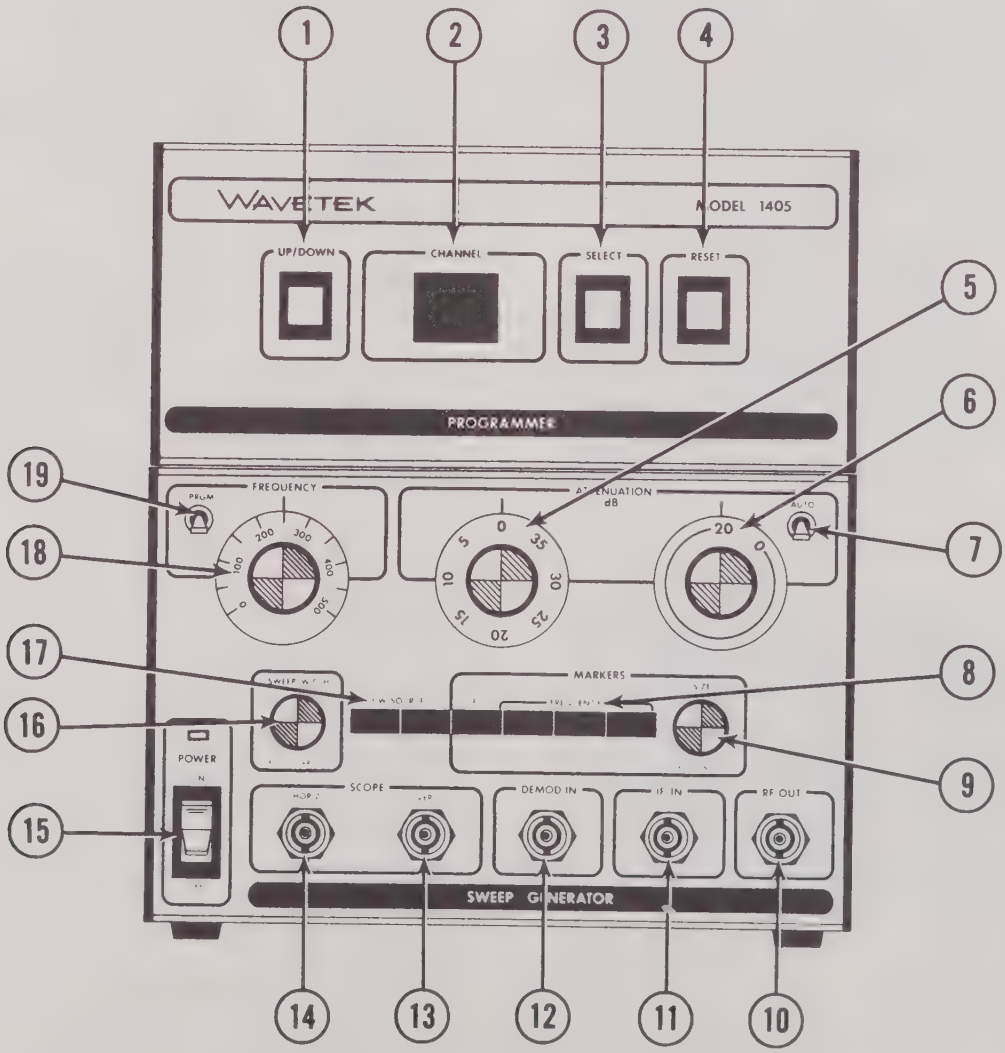


Figure 2-2. Front Panel

NOTE

Before operating the instrument, check that the rear-panel AC LINE FUSE is the correct value for the supply voltage (see Section 2.5).

2.4 DESCRIPTION OF FRONT PANEL

Refer to Figure 2-2.

(1) UP/DOWN pushbutton switch determines whether the SELECT pushbutton will increment (count up) or decrement (count down) the channel selection. (This function is also operated by the footswitch.)

(2) CHANNEL display shows the channel selected.

(3) SELECT pushbutton switch either increments or decrements the channel selection, depending on the UP/DOWN pushbutton setting when the PGM switch is in its up position. (This function is also operated by the footswitch.)

(4) RESET pushbutton switch selects channel 01.

(5) STEP ATTENUATOR provides calibrated adjustment of the RF output in 5 dB increments from 0 to 35 dB.

(6) VERNIER ATTENUATOR provides a 20 dB vernier adjustment of the RF output. When the AUTO switch is in its down position, or when the instrument is in remote operation, this control is not active.

(7) AUTO switch selects between automatic (Option C) and manual (VERNIER ATTENUATOR) level control.

(8) MARKER pushbutton switches control up to five optional IF markers, and up to three optional birdy markers for use with Option B-5. Birdy marker frequencies are engraved on pushbuttons.

(9) MARKER SIZE control adjusts the amplitude of pulse markers added to the demodulated envelope at the SCOPE VERT connector. When the knob is pulled out, the marker size is reduced by 90%.

(10) RF OUT connector (BNC) provides connection for the RF output signal.

(11) IF IN connector (BNC) accepts an IF sweep sample to generate IF conversion local oscillator tracking markers when Option B is installed.

(12) DEMOD IN connector (BNC) accepts the demodulated swept signal from the device under test so that markers and oscilloscope frequency and level indicators may be added, if Option C is provided. This signal is also used to control the automatic RF level circuits of Option C.

(13) SCOPE VERT connector (BNC) provides the combined demodulated RF, markers, and oscilloscope indicators for connection to an oscilloscope vertical input.

(14) SCOPE HORIZ connector (BNC) provides a 16 Vpp triangle waveform to drive an oscilloscope horizontal amplifier.

(15) POWER switch applies AC power to the power supply. The lamp indicates that the instrument is operating.

(16) SWEEP WIDTH control adjusts the display sweep width. When the knob is pushed in, the maximum sweep width is 500 MHz. When the knob is pulled out, the maximum sweep width is reduced to 50 MHz.

(17) CW SOURCE pushbutton switches activate the optional internal CW sources.

(18) FREQUENCY control selects center frequency when the PGM switch is in its down position.

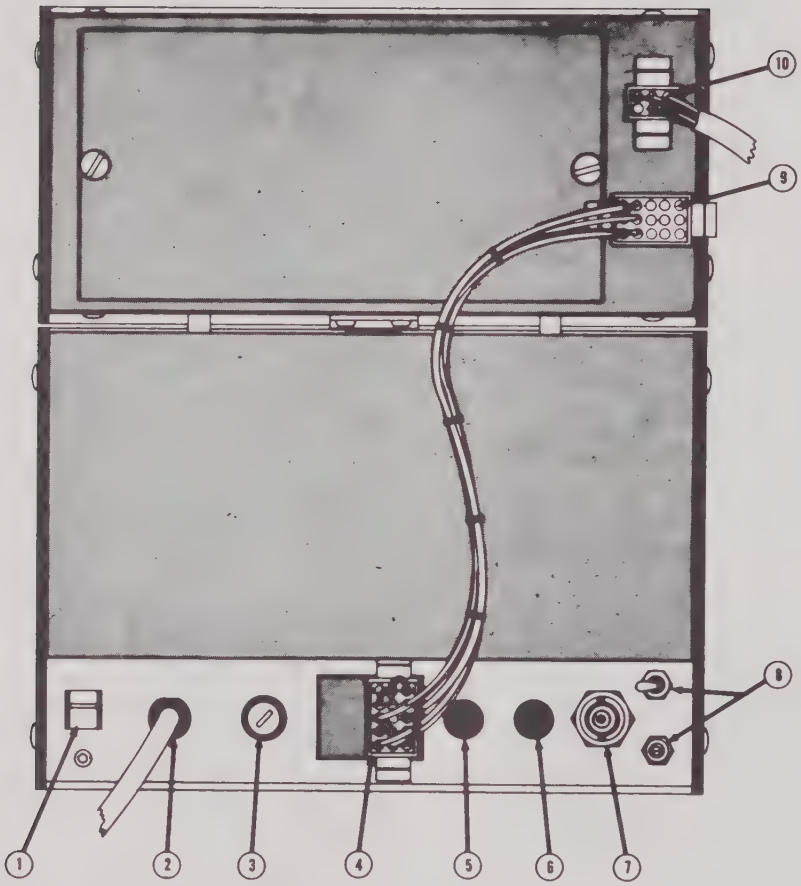


Figure 2-3a. Rear Panel

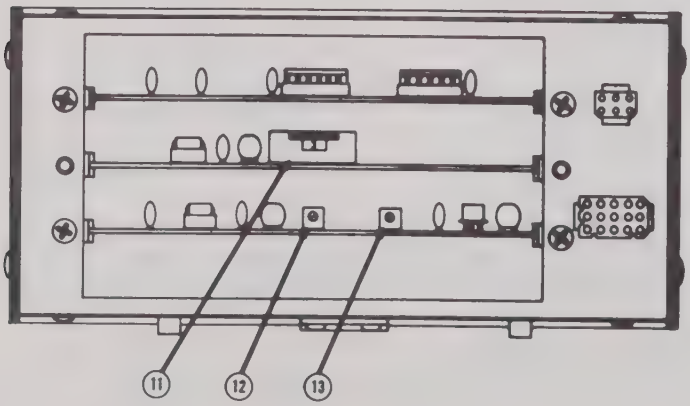


Figure 2-3b. Programmer Internal Controls

(19) PGM SWITCH determines whether the programmer (up position) or FREQUENCY control (down position) is active.

2.5 DESCRIPTION OF REAR PANEL

2.5.1 EXTERNAL CONTROLS

Refer to Figure 2-3a.

(1) AC LINE SWITCH enables the instrument to operate from either 115 VAC or 230 VAC supply mains.

(2) AC LINE INPUT cord provides connection to AC mains via 3 prong plug.

(3) AC LINE FUSE is time-delay; 0.5 for 115 VAC operation, 0.25 for 230 VAC operation.

(4) REMOTE jack and plug provide connections for programming of frequency and RF output level.

(5) OPTION mounting hole for BNC connector; typically used for CW source outputs, or Option B-5 2nd L.O. input.

(6) EXT MARKER INPUT connector (BNC) accepts an external CW input for generation of a birdy marker for use with Option B-5.

(7) PULSE MARKER OUTPUT connector (BNC) provides positive or negative pulse markers from Option B when installed.

(8) PULSE MARKER SIZE switch selects either negative or positive marker pulse. Control adjusts the amplitude of the pulses from 0 to more than 30 volts.

(9) Programmer input connector and harness provide connection between sweep generator and programmer sections. The interconnection harness connects to sweep generator REMOTE jack.

(10) FOOTSWITCH connector provides connection for the remote footswitch. The footswitch must be connected to permit programmer channel selection.

2.5.2 INTERNAL CONTROLS

The following controls are located inside rear-panel access plate. Refer to Figure 2-3b.

(11) Program Selector switch (inside cover) selects one of up to 8 preprogrammed channel sequences.

(12) Marker Centering control adjusts the marker centering about the channel center frequency.

(13) Coarse Tuning Range control adjusts the amplitude of the tuning voltage applied to the Sweep Oscillator and Phase Lock Modules.

2.6 TYPICAL OPERATING SET-UP

When initially setting up the instrument, first check the rear-panel AC LINE SWITCH and FUSE to ensure the instrument is set for operation with the available AC mains. When Option C, Automatic Level And Scope Indicators, is to be used, refer to Section 2.6.1 for adjustment of the internal controls required for proper operation. Be sure the AUTO switch is down before completing the set-up for manual operation.

Make connections between the sweep generator, the device under test and the oscilloscope as shown in Figure 2-4. Since hum, RF leakage, and spurious signal pickup must be kept at a minimum, it is essential that good connections and ground be maintained throughout the entire set-up. Coaxial cables with BNC connectors should be used wherever possible.

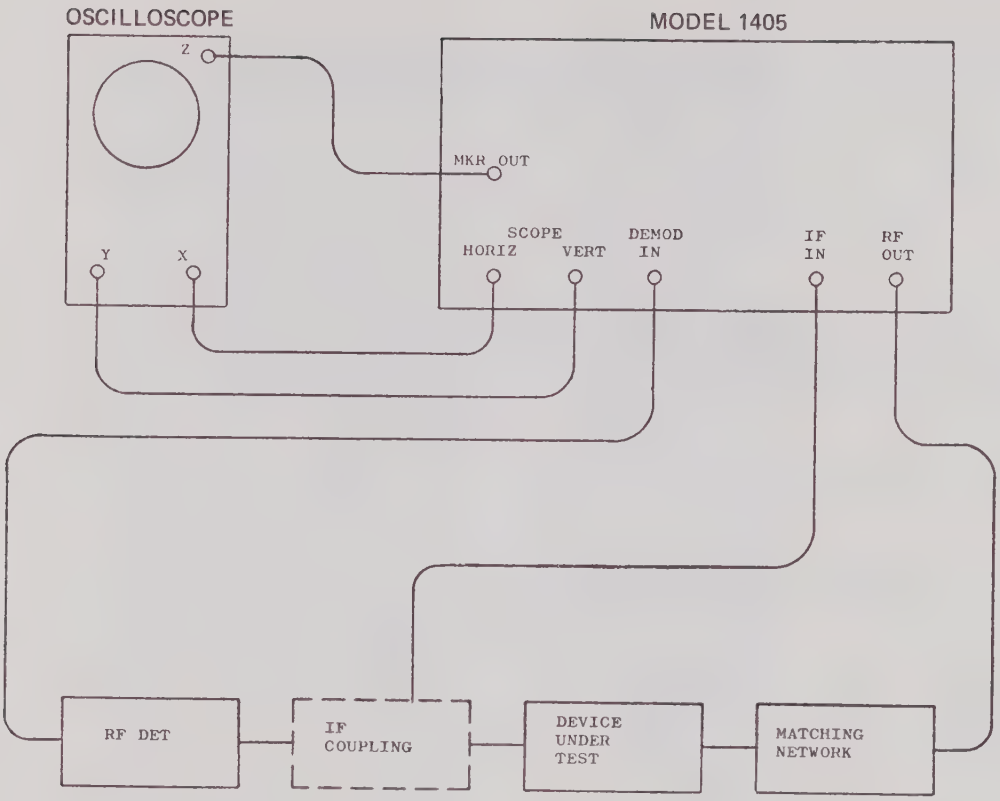


Figure 2-4. Typical Set-up

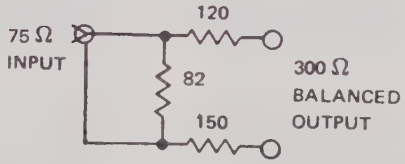


Figure 2-5. Resistive Pad

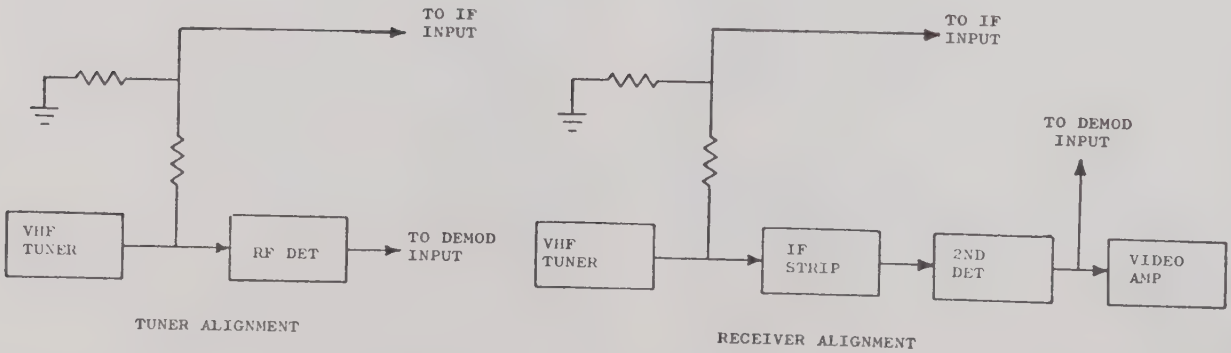


Figure 2-6. Typical Option B IF Coupling

The RF output cable is especially critical. It must have a characteristic impedance indentical to that of the sweep generator (75 ohms). The cable should be kept as short as practical (under 3 feet). A matching network must be used between the 75 ohm RF output cable and the 300 ohm balanced input of the tuner to ensure a constant-amplitude input signal to the tuner. Either a resistive pad (Figure 2-5) or a transformer matching network may be used. While the resistive pad is simple to construct, it provides more insertion loss than the balun-type transformer. The leads connecting the 300 ohm output of the pad to the tuner should be as short as possible (under 1 inch).

After the RF swept signal passes through the RF circuits of the device under test, it must be detected (demodulated) before being connected to the DEMOD IN connector or the oscilloscope vertical input. In the case of TV receiver alignment, the detector is already provided as a part of the receiver, while in aligning a tuner, an external detector must be used. The detected signal is then connected to the DEMOD IN connector on the front panel.

When Option B, IF Conversion Local Oscillator Tracking markers are used, an IF signal of 1 millivolt or more must be supplied to the front-panel IF IN connector. If IF markers are desired at trapped frequencies, the IF pickup must occur before the frequencies are trapped out, see Figure 2-6.

Turn the POWER switch on. The lamp should light, indicating an operating condition.

NOTE

The instrument requires no warm-up, and is ready for immediate use.

After making the necessary connections, set the AUTO switch, PGM switch, FREQUENCY control or Programmer CHANNEL, STEP and VERNIER ATTENUATORS, and SWEEP WIDTH as required. Turn on the IF markers (if desired) and adjust the MARKER SIZE control for optimum display.

NOTE

The VERNIER ATTENUATOR is inoperative in auto level operation.

2.6.1 INTERNAL SET-UP CONTROLS

The internal controls, located on module M8E-1, are used only when Option C, Automatic Level And Scope Indicators is installed. The controls are set according to the characteristics of the device under test, the type of alignment set-up used, and the operator's discretion to produce the desired display.

The instrument programmer section and sweep generator cover must be removed to provide access to the M8E-1 controls. (Refer to Section 4.2.)

GENERAL DISCUSSION

The main objective of RF tuner and other amplifier alignments is to maintain the circuit gain within the specified limits while retaining an acceptable pattern flatness at the desired pass band. With the detected response amplified to a level which would provide a scope pattern of 1 Vp and given typical limits as shown, the scope display could vary as shown in Figure 2-7.

By observing the pattern amplitude, it could be determined that the tuner gain is within acceptable limits, but the pattern flatness would be difficult to estimate. With Option C, the pattern amplitude is maintained at a

CHAN.	TUNER GAIN DESIGN LIMITS	
	LOW GAIN	HIGH GAIN
2	+30 dB	+42 dB
13	+24 dB	+34 dB

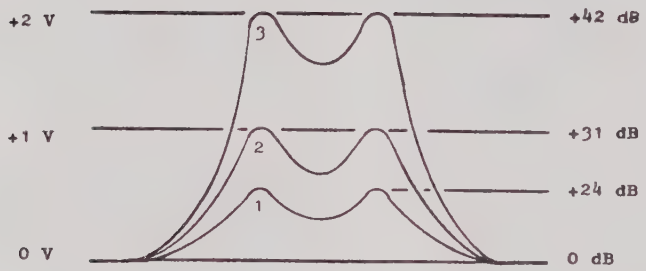


Figure 2-7. Typical Oscilloscope Displays

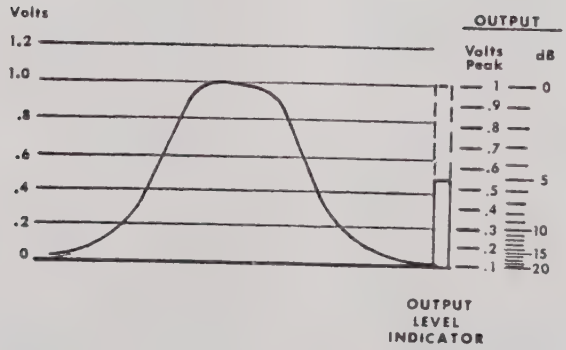


Figure 2-8. Option C Oscilloscope Display

fixed level of 1 volt by automatically controlling the RF input level. Flatness is now easy to determine; however, the tuner gain would not be known without knowing the RF input level. Option C provides a level indicator pedestal on the base line of the tuner response pattern proportional to the RF output of the instrument, and therefore inversely proportional to the gain of the tuner. For example, when the indicator is at maximum amplitude (1 volt), the RF output level is attenuated by 0 dB. If there is even less tuner gain, the pattern will become less than 1 volt while the indicator is saturated at 1 volt. As the tuner gain increases, the pattern will return to 1 volt and not increase further, while the indicator will decrease in amplitude in a linear fashion (see Figure 2-8).

The internal set-up controls provide up to 40 dB of DC gain in order to interface with either low or high level detected tuner output signals. Since the option requires a positive detected signal, a polarity reversing switch is also provided.

M8E-1 SET-UP INSTRUCTIONS

Connect the equipment as shown in Figure 2-4 and set the instrument for normal manual operation. Remove the programmer section and sweep generator cover and adjust the M8E-1 controls as follows:

Var Gain full ccw, (no gain)
Gain x 10
switch to right (no gain)
Polarity switch for a positive pattern

Disconnect the SCOPE VERT connector and adjust the Bal control for DC balance.

Reduce the oscilloscope's vertical gain to 1 volt full scale and switch the Gain x 10 switch to the left (20 dB gain). The tuner response pattern should now be visible. Turn the Var Gain control clockwise, if necessary, to obtain a 1 volt pattern. Note the amplitude of the RF level indicator pedestal.

Set the front-panel AUTO switch to its up position and readjust the Var Gain control to restore the RF level indicator pedestal to the same amplitude it had in manual operation. The instrument's RF output level is now being controlled automatically over a 20 dB range.

The module also provides a differentiated pulse which will change position on the base line relative to the center frequency of the instrument. The indicator Range and Cent controls are provided to allow it to cover the entire scope horizontal scan for the frequency range being used.

Switch the instrument frequency to the highest frequency channel being used. Adjust the Range control such that the indicator pulse is positioned slightly in from the right end of the display.

Switch the instrument frequency to the lowest frequency channel being used. Adjust the Cent control to position the pulse the same distance in from the left end of the display as the pulse was from the right end in the above step.

NOTE

The Cent and Range controls interact, so the above procedure must be repeated until the pulse is positioned properly on both the highestand lowest-frequency channels.

The oscilloscope horizontal axis may now be calibrated for the channels in use in ascending frequency.

2.7 OPTION B-5 OPERATION

Option B-5 enables the tuning of CATV tuner/converters by providing a 350 to 850 MHz sweep signal with a birdy marker at the converter's 2nd local oscillator frequency. (See also Section 2.11.4.) The option is contained in module SPM183B and a combination of M6S, M13S-1A, and/or SPM617 birdy marker sources. Module M6S provides one crystal-controlled birdy marker at a customer-specified frequency. Module M13S-1A provides three crystal-controlled birdy markers at customer-specified frequencies. Module SPM617 produces a birdy marker from an external CW source. Sources for up to three birdy markers may be installed in the instrument.

To align a converter using Option B-5, connect the equipment as shown in Figure 2-9. Enable the birdy marker source by pressing the appropriate engraved front-panel pushbutton. Two markers should appear on the oscilloscope display at frequencies corresponding to the actual and correct converter 2nd L.O. frequencies. Adjust the converter's 2nd L.O. such that the two markers coincide (zero beat).

2.8 CW SOURCE OPERATION

Connect the equipment as shown in Figure 2-9. (Not all options or test equipment shown in Figure 2-9 will necessarily be used.) (Splitters and/or couplers may be used in the set-up.) Enable the CW source at the video carrier frequency of the converter output channel by pressing the appropriate engraved front-panel pushbutton. Using the programmer, step through each converter input channel and adjust the converter's first local oscillator such that the birdy marker and the normal channel video carrier pulse marker coincide.

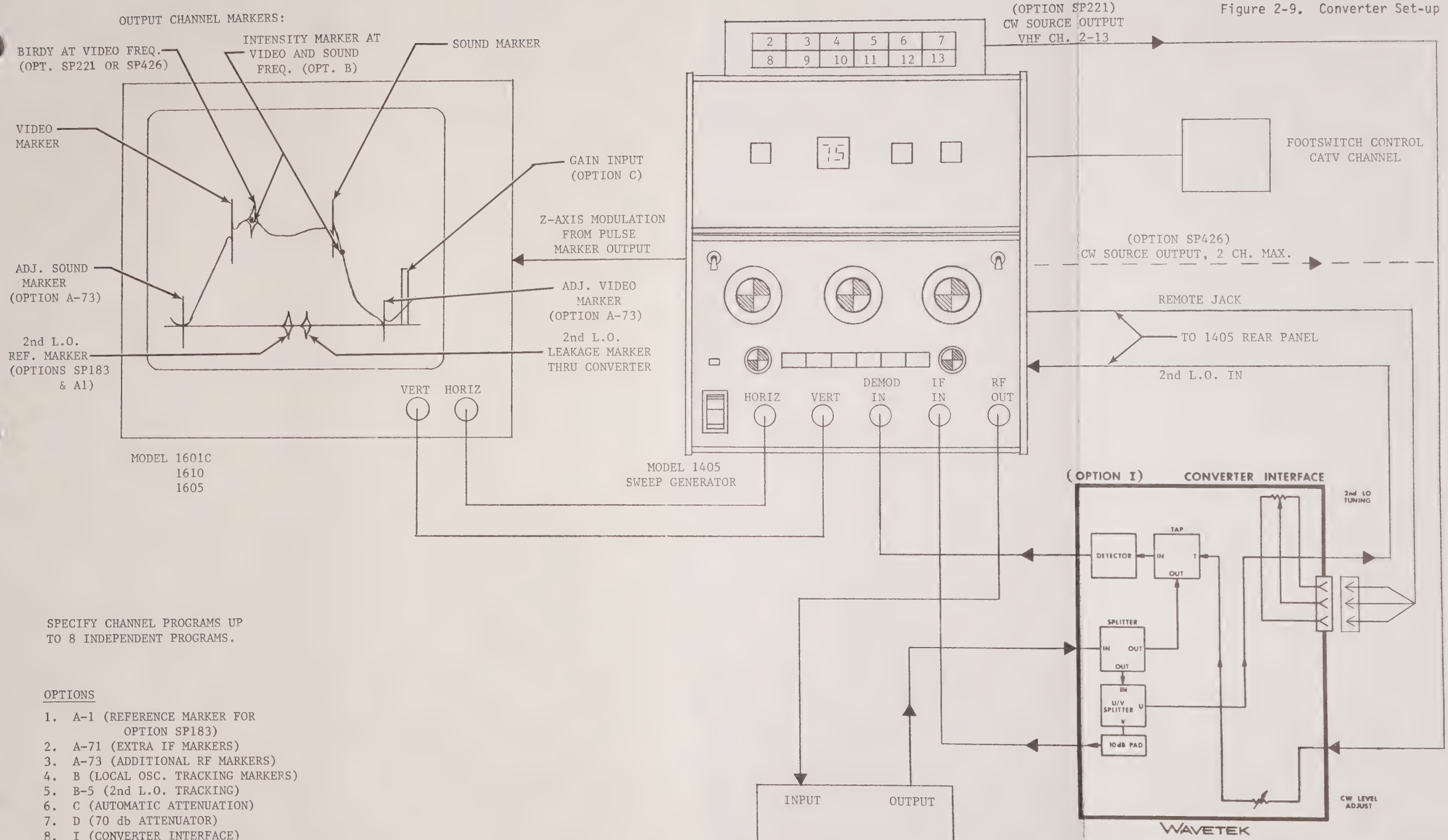
2.9 PROGRAMMER OPERATION

The programmer enables the sweep generator to select any desired channel via pushbutton or foot switch. Up to 8 separate channel sequence programs of up to 99 channels each (maximum total number of discrete frequencies is 240, in multiples of 0.25 MHz) can be stored in the programmer.

The program selected is determined by the Program Select switch setting. This PC-mounted thumbwheel switch is located inside the rear access panel of the programmer. To change the switch setting, remove the knurled screws securing the access panel and remove the panel. Set the switch for the desired program number (refer to the Program Sheet shipped with the instrument) and replace the access cover.

To select a channel, set the PGM switch in its up position and set the UP/DOWN switch for the desired counting direction. An arrow appears in the CHANNEL display to indicate whether the programmer will count up (increment) or down (decrement). Press the SELECT pushbutton. The CHANNEL display will change by 1 to show the selected channel. If the SELECT pushbutton is held in for approximately 1/2 second, the programmer will step rapidly through the channels until the SELECT pushbutton is released. Pushing the RESET pushbutton will cause the programmer to select channel 01.

The foot switch, when connected, operates in parallel with the SELECT and UP/DOWN pushbuttons. Pushing the footswitch halfway down increments or decrements the channel selection, while pushing the footswitch fully down switches the direction of count. The footswitch must be connected to permit channel selection.



SPECIFY CHANNEL PROGRAMS UP TO 8 INDEPENDENT PROGRAMS.

OPTIONS

1. A-1 (REFERENCE MARKER FOR OPTION SP183)
2. A-71 (EXTRA IF MARKERS)
3. A-73 (ADDITIONAL RF MARKERS)
4. B (LOCAL OSC. TRACKING MARKERS)
5. B-5 (2nd L.O. TRACKING)
6. C (AUTOMATIC ATTENUATION)
7. D (70 db ATTENUATOR)
8. I (CONVERTER INTERFACE)
9. SP426 (LOCAL OSC. TRACKING SOURCE)
10. SP617 (EXT. MARKER FOR SP183 OPTION)
11. SP221 (LOCAL OSC. TRACKING SOURCE)

MODEL 1405
TYPICAL HOOKUP & SCOPE DISPLAY

SIGNAL OUTPUTS

Pin 1	Ground
Pin 2	+18 V
Pin 3	-18 V
Pin 10	Sweep Ramp

SIGNAL OUTPUTS

Pin 4	Opt B-5 Cent Freq
Pin 6	Output Level
Pin 7	CW For Markers
Pin 9	Output Frequency
Pin 12	Sweep Width

INTERNAL CONTROL OUTPUTS

Pin 5	Vernier Attenuator
Pin 11	Sweep Width

Pins 13, 14, and 15 are normally used only in combined 1405/1503 set-up.

Pin 8 is unused.

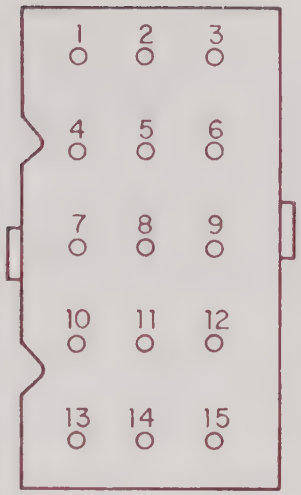


Figure 2-10. Sweep Generator REMOTE Jack

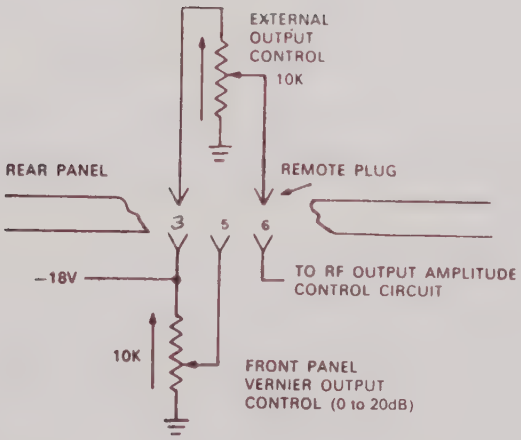


Figure 2-11. External Level Control

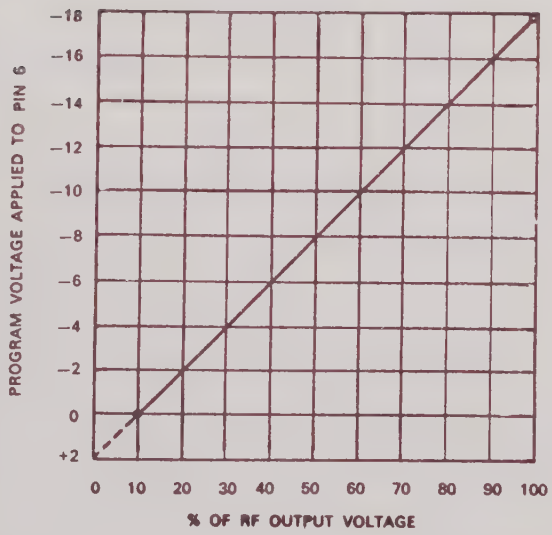


Figure 2-12. Program Voltage/RF Output

NOTE

The channel numbers shown on the CHANNEL display correspond to the channel numbers shown on the Program Sheets at the rear of this manual, and not necessarily to the standard TV channel numbers. Refer to the Program Sheets for programmed channel numbers and frequencies.

2.10 SPECIAL OPERATING NOTES

2.10.1 EFFECTS FROM OVERLOADING

The use of excessive input signals to the device under test can cause overloading. To assure that this condition is not present, and that the response is a true representation of the device under test, set the STEP and VERNIER ATTENUATORS for minimum output amplitude. Gradually increase the output amplitude until a response is obtained. Further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just far enough to restore the proper configuration.

2.10.2 MAKING MEASUREMENTS AT LOW LEVELS

When making measurements at low levels, radiation and ground loops become problems. Using double-shielded cables for carrying RF signals helps minimize the radiation problem. Ground loops causing hum pick-up can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the oscilloscope horizontal input. If the ground connection is made at the vertical input, an additional ground at the horizontal input will often result in hum pick-up.

2.11 REMOTE PROGRAMMING

Connections for remote control of output level, center frequency, and sweep width are provided on the rear-panel REMOTE jack. Also provided are connections for remote coupling of an automatic UHF sweep generator (Wavetek Model 1503) to the Model 1405. The REMOTE jack and its pin functions are shown in Figure 2-10.

Normal front-panel operation is provided by a REMOTE programming plug with jumpers between pins 5 and 6, 8 and 9, and 11 and 12.

2.11.1 OUTPUT LEVEL CONTROL

To provide external control of the 0 to 20 dB VERNIER ATTENUATOR, remove the jumper from pins 5 and 6 of the REMOTE plug and connect an external control as shown in Figure 2-12. The RF output is a linear function of the programming voltage as shown in Figure 2-13.

2.11.2 CENTER FREQUENCY CONTROL

To provide external control of center frequency, connect pin 9 to an external frequency control as shown in Figure 2-14.

2.11.3 SWEEP WIDTH CONTROL

To provide external control of sweep width, remove the jumper from pins 11 and 12 of the REMOTE plug and connect pin 12 to an external sweep width control as shown in Figure 2-15.

NOTE

The circuit as shown will control the wider sweep width range (1 to 500 MHz). To externally control the narrower range (1 to 50 MHz) normally activated by pulling the SWEEP WIDTH control out, a 91 kohm resistor should be connected between REMOTE plug pin 10 and the external sweep width control.

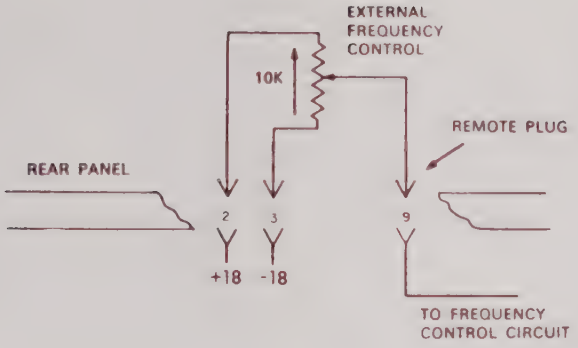


Figure 2-13. External Frequency Control

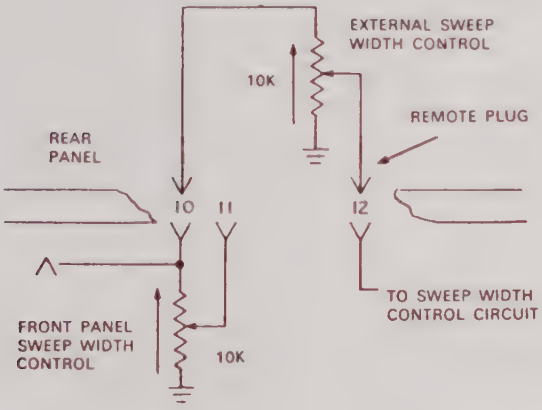


Figure 2-14. External Sweep Width Control

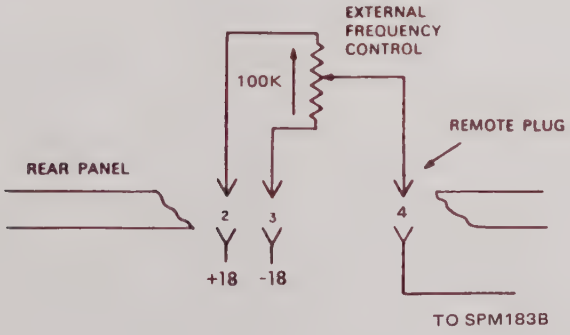


Figure 2-15. Option B-5 External Center Frequency Control

2.11.4 OPTION B-5 CONTROL

On instruments equipped with Option B-5, it is sometimes desirable (for example, to adapt the option to converters with different output channel frequencies) to vary the UHF swept frequency range of module SPM183B. To accomplish this, connect pin 4 of the REMOTE plug to an external control as shown in Figure 2-16. The center frequency of the SPM183B UHF sweep can then be varied over its entire range via the external control.

2.11.5 COMBINATION 1405/1503 OPERATION

Figure 2-17 shows the typical set-up for operation of a 1405/1503 combination. The rear-panel REMOTE plugs of both instruments are removed, and a special combining harness assembly (K106) is substituted. The K106 harness also contains a UHF/VHF change over switch (refer to Figure 2-18). The plug adjacent to the switch is installed on the Model 1405 (slave).

The Model 1503 must have Options B (Local Oscillator Tracking), C (Automatic Level And Scope Indicators), and E (Automatic Frequency) installed. The Model 1405 must have the M2E-3 Sweep Drive module replaced with an M2E-2. If Option C is installed in the Model 1405, module M8E-1 must be removed and replaced with an M8 module base. The AC line phase must be the same for both instruments.

The center frequency, sweep width, and output level (0-20 dB VERNIER ATTENUATOR range) of each instrument are controlled from the Model 1503, with the Model 1405 front-panel FREQUENCY (and programmer), SWEEP WIDTH, and VERNIER ATTENUATOR controls inactive. The UHF/VHF changeover switch selects which instrument is operating and which is in "standby" mode.

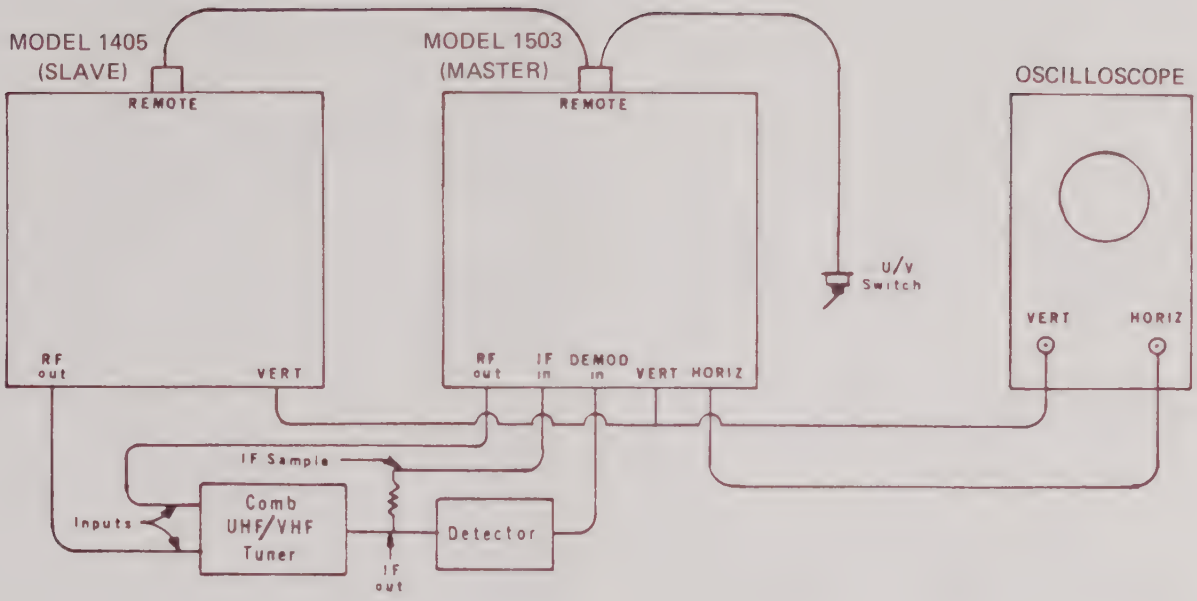


Figure 2-16. Combination 1405/1503 Set-up

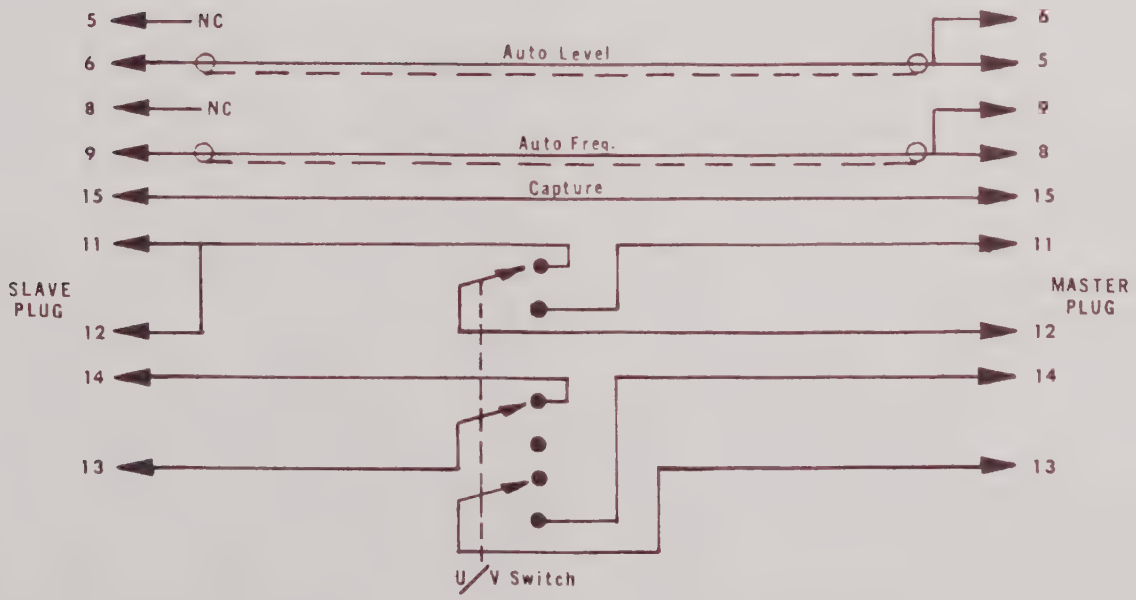


Figure 2-17. K106 Adapter Harness

3.1 INTRODUCTION

This section first presents an overall block diagram analysis followed by a more detailed description of each subassembly.

Before beginning the actual circuit description, it would be well to consider the mechanical arrangement of the instrument. This will enable the following block diagrams and circuit descriptions to be associated with their physical positions, thereby providing a better understanding of the overall instrument.

3.2 SWEEP GENERATOR OVERVIEW

The block diagram in Figure 3-1 contains both block and subassembly information.

The Power Supply contains regulated ±18 V sources, square wave and triangle wave generators, and a pulse marker amplifier circuit.

The two power sources provide the voltage to the front-panel FREQUENCY control and programmer while the triangle wave generator supplies the sweep ramp to the front-panel SWEEP WIDTH control. The programmer circuits set the tuning voltage required for each channel center frequency. The output signals from the FREQUENCY control or programmer and the SWEEP WIDTH control are then fed to the M2E-3 Sweep Drive module where they are combined into a single signal which drives the frequency-determining varactor diodes in the SPM656 Sweep Oscillator module. Necessary level shifting, shaping, and amplitude control is provided by the Sweep Drive circuit.

The square wave generator turns off the RF output and marker circuits during retrace, and controls the timing of other circuits in the instrument.

The RF Sweep Generator circuits are contained in the SPM656 Sweep Oscillator module.

The sweep signal is generated by heterodyning two UHF sweep oscillators in a diode mixer. The resultant difference signal is then amplified in a wideband amplifier and applied to a voltage-variable attenuator, the final output wideband amplifier, the monitor diode, and the leveling amplifier.

Leveling of the RF output is accomplished by the monitor diode which measures the RF voltage and compares it to a reference voltage supplied by the OUTPUT VERNIER control. Any error between the two voltages is amplified in the leveler amplifier. The error voltage is then connected to the voltage-variable attenuator at the input of the final wideband amplifier. This closed-loop system, which compensates for amplitude variations in the sweep oscillator, mixer, and amplifiercircuits, also creates a zero impedance at the monitor point. In order to create a 75 ohm source impedance, a 75 ohm resistor is connected between the zero impedance point and the RF output system.

The output from the SPM656 module is then connected through the STEP ATTENUATOR to the front-panel RF OUT connector.

The marker circuit is located in the Programmer, M202 and Marker Adder module, M8. The marker adding function of the M8 module is also contained in the M8E-1 Automatic Level module, (Option C).

The M202 module accepts an RF signal from a second SPM656 in the programmer section. This signal is coupled to a dual gate MOSFET amplifier tuned to 2.25 MHz by LC tank circuits across one of its gates and in the drain load. The response is further amplified, demodulated, and sampled by an IC inverter which provides automatic gain control (AGC) for the tuned amplifier. The response is then amplified to saturation, producing sharp, negative-going pulses at the RF carrier frequencies. These two pulses are added to the demodulated envelope in the M8 module.

The optional IF marker circuit in the M13J-2 module consists of a sweep sample amplifier, five independent plug-in crystal filters which generate the basic marker pulses in separate detector amplifier circuits, and a common pulse amplifier. The negative-going output pulses are added to the demodulated envelope in the M8 module.

The optional M7E module provides pulse-type local oscillator tracking markers generated from an IF sample from a TV tuner or receiver. The conversion circuits, which also have AGC to prevent loss of markers from insufficient IF sample during tuner alignment, convert the IF sample to approximately 12.25 MHz. The converted signal generates RF markers in three crystal filters at converted equivalent frequencies. The crystal filter outputs are detected and amplified in identical detector/amplifier circuits, and are applied to the common marker pulse circuit which generates sharp negative-going marker pulses.

The marker pulses are routed to the marker pulse amplifier (in the PS7 Power Supply) which provides either positive-or negative-going pulse markers at the rear panel.

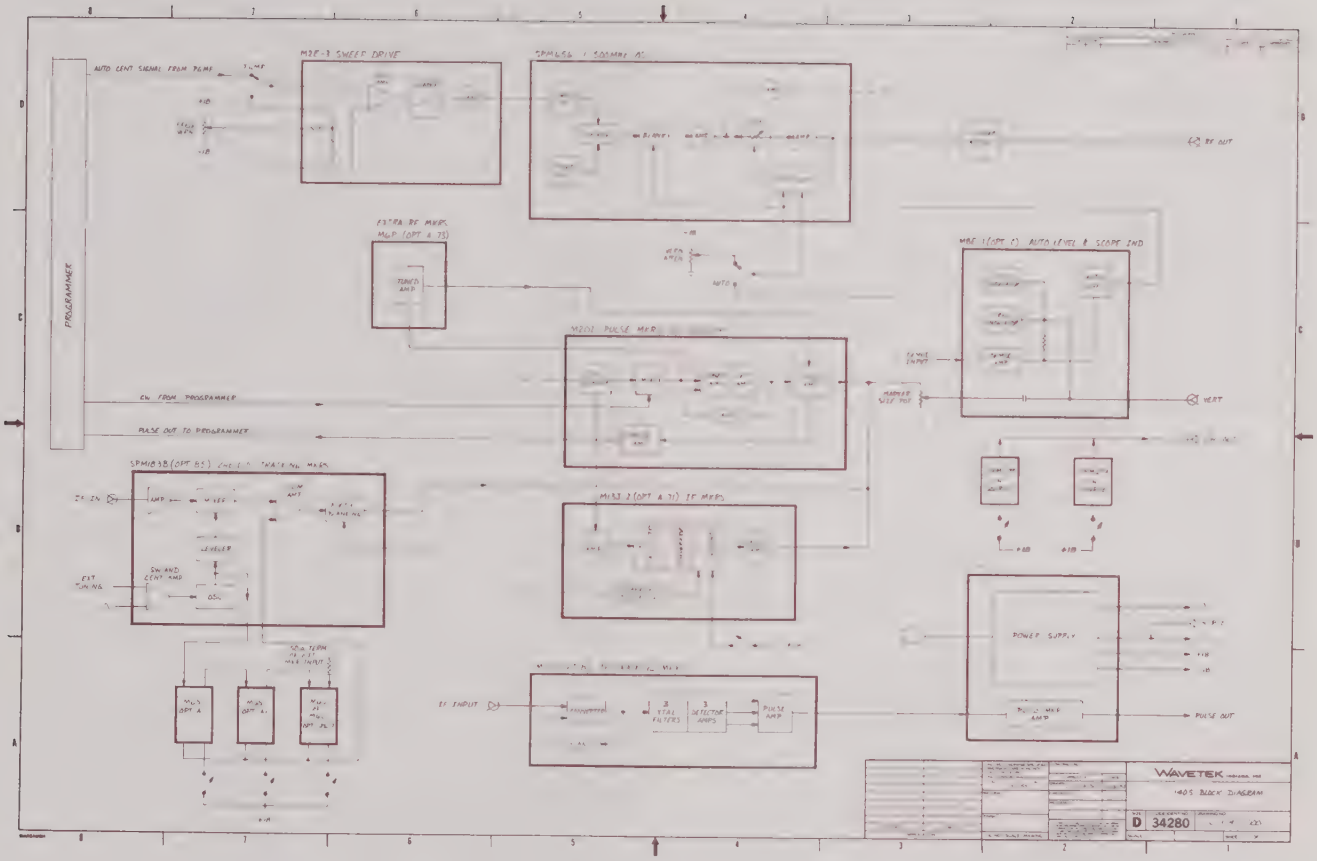
The Option C automatic level, level indictor, and frequency indicator circuits are contained in the M8E-1 module. The module also contains high-impedance adjustable-gain oscilloscope preamplifier circuits and pattern inverters to permit automatic leveling (attenuation) with either high-or low-level tuners without using external DC amplifier probes. The level indicator pedestal, the frequency indicator pulse, and the marker signals from the front-panel MARKER SIZE control are combined with the demodulated input signal for connection to the oscilloscope vertical input.

When Option C is not installed, module base M8 is used in place of module M8E-1. In this module, the demodulated input is capacitively coupled to the SCOPE VERT output connector. No other circuits are provided in this module.

THE FOLLOWING CIRCUIT DESCRIPTIONS ARE REFERENCED TO THE SCHEMATICS APPEARING IN SECTION 6.

3.3 POWER SUPPLY (PS7)

The PS7 Power Supply provides two regulated DC voltages, a square wave, a triangle wave, and amplified marker pulses.


PROGRAMMER
MDE-3 SWEEP DRIVE
SPM456 1 SOMHz AF
MDE-1(OPT C) AUTO LEVEL & SCOPE IND
M201 PULSE MOD
M203 2(OPT A 71) IF MOD
SPM883B(OPT 85) CW/FM WAVE SHAPE MOD
POWER SUPPLY
PULSE MOD AMP
PULSE OUT
EXT SWEEP
EXT TUNING
WAVETEK
1405 BLOCK DIAGRAM
D
34280

AC POWER & RECTIFIER CIRCUITS

A dual-primary transformer allows operation at a line voltage of 115 or 230 volts. AC power is supplied via a 3-prong plug and is switched by the front-panel POWER switch. The transformer is located away from the Sweep Drive module to reduce magnetically-coupled line ripple.

Unregulated plus and minus voltages are supplied by two full-wave rectifier circuits filtered by C1 and C7. A 12 pin plug, mounted to the printed circuit board, provides access to three unregulated voltages, the regulated ±18 V supplies, square wave, triangle wave, and an input to the pulse marker amplifier.

+18 VOLT SERIES REGULATOR

Regulation is provided by IC2 which contains its own internal reference supply. Resistor R9 provides an adjustment to +18.00 volts. An external pass transistor, Q2, boosts the current capability, and transistor Q1 improves the current limiting characteristics of IC1 by providing amplification before limiting. The +18 volt supply is protected against reverse voltage by diode CR7.

-18 VOLT SERIES REGULATOR

The voltage reference for this supply is obtained from the +18 volt supply through resistor R20. Resistor R19 provides feedback, applied to IC2, which provides high gain, forcing transistor Q5 to maintain a regulated voltage at the collector. Transistors Q3 and Q4 provide the series pass element and are connected as a compound emitter follower so that the voltage across resistor R13 is not loaded heavily. Short-circuit protection of transistor Q4 is provided by diode CR8. Current limiting is provided by transistor Q5 when transistor Q6 conducts sufficiently to forward bias diodes CR9 and CR10. Reverse voltage protection is provided by diode CR12.

SQUARE WAVE GENERATOR

The 24 volts AC from power transformer T1 is squared by comparator IC3A. Diodes CR13 and CR14 provide protection to the inverting input by limiting the voltage range to one volt. The square wave output drives the triangle generator input and is also applied to the base of Darlington emitter follower Q7. CR15 limits the negative output to one volt. A positive 15 volt, negative 1 volt square wave is routed to pin 10 of P2 where it is provided to blank the RF output during retrace and to control the timing of other circuits in the instrument.

TRIANGLE WAVE GENERATOR

The symmetrical square wave output of IC3A is adjusted by R26 and is AC coupled to integrator IC3B to restore symmetry about zero. Diodes CR16 and CR17 protect the inverting input by limiting the voltage range to one volt.

Capacitor C13 in the feedback network provides the integrator configuration. This signal, applied to pin 8 of P2, provides the sweep ramp and oscilloscope horizontal drive, and controls the timing of other circuits in the instrument.

MARKER AMPLIFIER

Negative-going marker pulses from the M7E (Option B) module are routed through pin 7 of P2 and AC coupled to the base of PNP inverter Q12. The collector signal is coupled through R41 to the base of NPN inverter Q13.

Positive-going pulses are selected from the rear-panel PULSE MARKER

SWITCH, S2, and coupled to the MARKER SIZE control, R44. The pulse is then applied to the PULSE MARKER OUTPUT connector, J5.

3.4 SWEEP DRIVE (MODULE M2E-3)

The M2E-3 Sweep Drive module provides the drive voltage to the varactor diodes in the SPM656 Sweep Oscillator module as determined by the programming voltage applied to pins 5 and 7 of the M2E-3 by the FREQUENCY (or programmer) and SWEEP WIDTH controls. R4, and R5 divide the frequency program so that it is equal to the sweep width program. The programs are summed to a standard voltage level in input amplifier IC1A, and then fed to the shaper circuit. The shaping diodes (CR1 through CR5) conduct at levels determined by a resistor string driven by constant current source Q1. As each diode conducts, an additional current is fed into the summing junction of the output amplifier, IC1B. The output amplitude is set by R32, the Sweep Width control.

3.5 SWEEP OSCILLATOR (SPM656)

The sweep signal is generated by heterodyning the output of a UHF voltage-controlled sweep oscillator with the output of a 1 GHz fixed-frequency (CW) oscillator in a diode mixer. The difference frequency (1 to 500 MHz) is amplified by a wideband amplifier. A PIN diode voltage-variable attenuator, providing vernier RF level adjustment, is controlled by a leveler amplifier, which is regulated by an ALC voltage from the monitor diode.

The RF output of common base configured fixed oscillator Q1, operating at a frequency of approximately 1000 MHz, is coupled through indictors L1 and L2 to opposite terminals of the double-balanced mixer consisting of diodes CR1, CR2, CR3, and CR4.

Oscillator Q3 operates at a frequency of approximately 1000 MHz to 1500 MHz. The average frequency is adjusted by resistor R10, which controls the average bias on the cathodes of varactor diodes CR7, CR8, and CR9. The sweep drive voltage at module pin 9 is applied to the varactor diodes, varying their junction capacitance, thereby causing the oscillator frequency to vary. The sweep oscillator output is coupled to the other opposing terminals of the double-balanced mixer through inductor L5. The resulting difference frequency (0 to 500 MHz) is then preamplified by IC102 and IC103. Transistor switch Q101 provides RF blanking by shutting this preamplifier off during retrace.

Two RF outputs are provided from the preamplifier. One output is coupled via R105 and C111 to wideband amplifier IC107. The output of this amplifier is provided at J2 and J3 as the sweep sample signal to the marker generating circuits. The second RF output signal is coupled through C108 to the voltage-variable attenuator consisting of PIN diodes CR101 and CR102, which provides variable RF conductance proportional to the positive current signal from the leveler amplifier.

Leveler amplifier IC101B provides leveling of the RF output by supplying a positive current to the voltage-variable attenuator. A positively increasing output voltage from the leveler amplifier will produce an increasing RF output level.

RF blanking is effected by a positive input voltage from pin 10 to transistor switch Q101, which causes the leveler output to go negative during retrace, thus shutting off the voltage-variable attenuator. Monitor diode CR103 provides a negative DC

voltage, related to the RF output level, to the inverting input of the leveler amplifier. Since an increasingly negative voltage at this input will reduce the positive current supplied to the voltage-variable attenuator, the RF output level is held constant, by negative feedback, at a level determined by the reference voltage at the leveler amplifier's non-inverting input. This reference voltage varies directly with the level program at pin 7. The magnitude of this negative voltage is determined by the Level Max control, which sets the maximum RF level when the program voltage is maximum. The Level Min control provides a small negative reference level when the program voltage is zero.

Three wideband amplifier stages, IC104, IC105, and IC106, amplify the signal from the voltage-variable attenuator by about 40 dB, with reduced frequency response below 1 MHz and above 500 MHz. Since the closed-loop leveling system establishes zero impedance at the monitor point, R17 sets the output impedance at 75 ohms.

3.6 MARKER/LEVELER (MODULE M202)

The unleveled sweep sample signal from the SPM656 Sweep Oscillator module enters the M202 via J1. The sweep sample is then leveled by CR1, CR2, CR3, IC1 and its associated circuitry. This signal is then output via J2 to the programmer. The leveled sweep sample is also fed to double-balanced mixer MX1. The mixer mixes the sweep sample with a CW signal supplied by the programmer at J3. The output of the mixer is then fed to parallel LC tank L3/C6 which is tuned to 2.25 MHz. The output of the tank is a 2.25 MHz RF burst when the sweep sample frequency is 2.25 MHz above or below the frequency of the CW signal. This signal is then fed to Q1, a dual gate FET amplifier with AGC. The output of the FET is connected to another 2.25 MHz bandpass tank to sharpen the shape of the bandpass. Q2 serves as a buffer stage, while Q3 amplifies the RF bursts. CR4 is an envelope detector that converts the RF bursts to DC pulses. Q4 is a buffer stage feeding IC2, which further amplifies the pulses and generates an AGC control voltage which is fed back to Q1 via CR5 and R31. This AGC loop maintains a constant pulse amplitude.

Q5, Q6, Q7, and Q8 amplify the DC pulses into saturation so that the resultant output is two narrow 0 to -18 V pulses. When the A-73 Option is used, the extra pulse pair enters at pin 12 and is summed with the normal pulse markers at the emitter of Q8. Q9 and Q10 perform the same function as Q7 and Q8 so that the pulse markers can be output at two different module pins. The output at pin 7 is summed with any other markers (such as the Option A-71 IF markers), and is available at the front-panel SCOPE VERT connector. The output at pin 8 is fed only to the programmer to be used to auto center the oscilloscope display. (If the A-71 IF markers were also routed to the programmer, they would tend to confuse the auto centering circuits in the programmer.)

3.7 ADDITIONAL RF MARKERS (OPTION A-73)

When additional RF markers are required at each channel, an M6P Marker module containing a MOSFET amplifier tuned to the difference between the required marker frequency and the channel center frequency, plus detector, AGC, and pulse amplifier circuits is installed.

The heterodyned video from the double-balanced mixer in the M202 module is input to pin 2 of the M6P module, where it is applied to the gate of Q1.

MOSFET amplifier Q1 is tuned by parallel-resonant tank L1/C3 at one gate, and by L2 and C8 in the drain load. The output response is demodulated and amplified by Q2 and Q3, and amplified to saturation by Q4. Operational amplifier IC1 amplifies the pulse response, and monitor circuit CR2/C5 automatically adjusts the gain of the tuned amplifier, Q1, by regulating the bias on the second gate. This AGC keeps the pulse markers at the same level of saturation throughout the range of the instrument. Transistor stages Q5, Q6, and Q7 further develop the signal to fast-rising pulses output via pin 3 to the M202 module. The B-voltage required to operate the M6P module is provided by the M202 module to pin 3 of the M6P.

3.8 IF MARKERS (OPTION A-71)

This option (module M13J-2) contains a sweep sample amplifier, five crystal filter circuits, pulse amplifiers and SCS switches, and a common output pulse amplifier. A blanking circuit turns the markers off during retrace.

The sweep sample amplifier, Q1, is a common emitter broadband amplifier. The collector load of the amplifier, RF transformer T1, is tuned to match the input impedance of the crystal filter circuit.

The crystal filters are very high "Q" resonant circuits developing sharp bursts of RF energy at their series-resonant frequencies. These bursts of RF are detected by CR1 and applied to the base of the first pulse amplifier, Q2. Pulse amplifiers Q2 and Q3 convert the small output from the crystal filters to DC voltage pulses when B+ is supplied to their collectors from the IF MARKER pushbutton switches. The amplified pulses are then applied to the anode gate of the SCS, Q4. The pulses are further amplified by Q5 and Q6, which are common to all five filter channels. The sharp, negative-going pulses are then routed to the marker adder circuits in the M8 or M8E-1 module.

The marker blanking circuit, Q7, Q8, and Q9, turns Q4 off during retrace by removing B+ from its anode. A blanking pulse from Q7 biases Q5 off during retrace.

3.9 IF CONVERSION L.O. TRACKING (OPTION B)

This option (module M7E) contains a conversion circuit consisting of a bandpass filter, RF amplifier, local oscillator, mixer, 10 to 20 MHz IF amplifier, and IF transformer. It also contains an automatic gain control (AGC) circuit, three crystal filters and their associated pulse preamplifier stages, a common marker pulse amplifier, and a reference pulse amplifier.

The input to the M7E is a sample of the swept IF signal from the tuner being tested by the sweep generator. One output is a pair of pulses which correspond to the points in time when the tuner IF output sweeps through the video and sound frequencies. The second output is a pulse midway between the frequencies of the pulse pair.

CONVERSION CIRCUIT

The bandpass filter consists of the L/C tuned networks at the input to MOSFET Q1. The filter passes the frequency band from 30 50 MHz. Q1 is an amplifier that couples the IF frequencies to one input of mixer Q3. The other input receives the 55.75 MHz signal from crystal-controlled Colpitts oscillator Q2. The AGC voltage is also applied to the mixer at this point. The 55.75 MHz local

oscillator heterodynes with the output of Q1 to provide output frequencies of approximately 8 to 21 MHz. After conversion, 10 MHz corresponds to 45.75 MHz input, 12.25 MHz corresponds to 43.5 MHz, and 14.5 MHz corresponds to 41.25 MHz.

Mixer Q3 and MOS FET amplifier Q4 drive stagger-tuned Pi-networks to provide the required flat response. Frequencies below 10 MHz are attenuated by choke L8. Frequencies above the desired band are attenuated by the low-pass filtering of the Pi-networks.

AGC CIRCUIT

A sample of the signal level is coupled from the collector of Q6 to the AGC circuit consisting of monitor diode CR2 and integrated circuit IC1.

CRYSTAL FILTERS AND PULSE PREAMPLIFIERS

The secondary of T1 is center tapped to provide two opposite-phase signals to each of the three crystal filters. The crystal filter outputs are nulled for zero output, except at resonance, by variable capacitors C30, C31, and C34. These crystal filters provide sharp bursts of energy at their series-resonant frequencies. In each case, the crystal in the filter is selected to produce a frequency equal to the difference between the M7E local oscillator (55.75 MHz) and the desired marker. (For U.S. standard sound and video, these are: 55.75 - 41.25 = 14.5 MHz, and 55.75 - 45.75 = 10 MHz.) The RF bursts are detected by CR3 and amplified by Q7. Emitter follower Q8 provides a low impedance to drive amplifier Q9, providing sharp pulse inputs to the common pulse marker amplifier, Q10 and Q11.

REFERENCE PULSE AMPLIFIER

A second output from Q8B drives the reference pulse amplifier. The first stage, CR5 and Q12, duplicates the function of CR4 and Q9, as described above. The second stage, Q13, amplifies and inverts the pulse.

3.10 CONVERTER BASELINE L.O. TRACKING MARKERS (OPTION B-5)

This option (module SPM183B) provides birdy markers at a TV tuner/converter's 2nd local oscillator actual and specified frequencies to allow easy alignment of the converter. The option is contained in module SPM183B and various birdy marker sources. A sample of the converter output (which contains a small sample of the converter's 2nd L.O. frequency) is fed into module SPM183B. The difference frequency between the 2nd L.O. and the SPM183B's internal UHF sweep (a pre-set portion of the 350 to 850 MHz range) produces a birdy marker at the actual 2nd L.O. frequency. A birdy marker source produces a birdy marker at the specified 2nd L.O. frequency. The converter's 2nd L.O. is then adjusted until the markers coincide.

3.11 AUTOMATIC LEVEL AND SCOPE INDICATORS (OPTION C)

This option (module M8E-1) provides gain adjustable up to 40 dB to the demodulated input from the front panel, selectable polarity circuits, and an RC network for adding markers to the demodulated signal. It primarily provides an automatic RF level (attenuation) DC voltage to the SPM656 level control input, automatically adjusting the RF output level

for a constant-amplitude demodulated tuner response. The module also provides oscilloscope indications of the RF level program by means of a vertical pedestal (pulse) on the retrace base line whose amplitude varies directly with the RF level program amplitude, and of the frequency (tuning) program by means of a narrow differentiated pulse that moves across the base line in ascending frequency from left to right.

DEMODULATED INPUT AMPLIFIER, INVERTER, AND MARKER ADDER

The demodulated response of the tuner under test is fed from the DEMOD IN connector to pin 8, and is AC coupled to IC1A. The Var Gain potentiometer in the feedback network adjusts the amplifier gain. The output signal is applied to the low gain (x1) contact of switch S1, and to IC1B, which is set for a ten-to-one voltage gain (20 dB). The 20 dB Gain adjustments are provided so that automatic RF level programming may be used with both high-and low-level tuners without using external active DC probes. The signal at the common contact of the Gain x 20 switch, S1, is capacitively coupled to IC2A. Q1, which saturates when the positive blanking square wave is applied to its base, is provided to restore DC level, and Balance control R11 adjusts for a zero volt baseline. The output signal is applied to the (inverted) contact of Polarity switch S2, and to the inverting input of IC2B, which is set for a gain of -1. The inverted signal is fed to the (normal) contact of the Polarity switch. A positive response pattern is selected for the proper operation of the automatic level circuits. (The high gain, wide range, and selectable-polarity circuits just described are provided so that responses of various DC levels may be brought within the operating range of the auto level circuitry, permitting the use of detectors of either polarity in the test set-up without requiring the use of external polarity-inverting amplifiers.)

The signal at the common contact of the Polarity switch is fed through R14 and pin 9 to the front-panel SCOPE VERT connector. Markers from pin 7 are combined with the output signal through C26.

AUTOMATIC LEVEL CIRCUITRY

The auto level circuitry senses the demodulated peak response at each sweep cycle, compares it to a pre-set reference voltage, and regulates the program voltage to the 20 dB PIN diode attenuator in the Sweep Oscillator module so as to maintain the tuner response at a one volt level. This function is implemented by two sequential time-related pulses. The first is a sampling pulse occurring during the first half of the retrace, the second is a discharge pulse which occurs during the remaining half of the retrace cycle.

The peak level of the demodulated response is detected by diode CR4 and capacitor C19. The RF blanking square wave at pin 10 is applied to the non-inverting inputs of comparators IC5A and IC5B. The triangle wave at pin 4 is applied to the non-inverting input of comparator IC5A, and the inverting input of IC5B. These combine to produce a positive pulse during the first half of retrace. This pulse, by turning FET switch Q4 on, transfers the voltage on C19 to C20, which is connected to error amplifier IC6A. C20 holds the voltage for the duration of the sweep cycle. The output of IC6A is connected to follower IC6B.

The output of IC6B is fed through zener diode CR7 to the base of emitter

follower Q6. Since this program voltage will vary between -18 and 0 V, Q6 is supplied from -30 V. R59 in series with the collector provides current overload protection.

When the demodulated output voltage exceeds 1.25 volts, the response at the common of S2 causes common base transistors Q8 and Q9 to conduct, turning on FET switch Q7. This inserts R63 into the IC6B feedback loop, increasing the feedback to quickly adjust the automatic level program.

During the last half of the retrace cycle, FET switch Q3 discharges peak-detector capacitor C19 so that the detector network is reset for the next sweep cycle.

RF LEVEL INDICATOR PULSE CIRCUITRY

The RF level program is fed to pin 6 and applied to the inverting input of operational amplifier IC3A, which converts the -18 to 0 V RF level program to a +1 to 0 V program when it is combined with the demodulated output signal at module pin 9.

The RF-blanking square wave from pin 10 is differentiated by capacitor C7 and diode CR1, and is applied to the non-inverting input of IC3B, which amplifies the positive leading spike derived from the start of retrace. The positive-going pulse output from IC3B overrides the negative bias on the gate of FET switch Q2, turning it on. When Q2 conducts, the converted level-program voltage at R35 is transferred to module pin 9. The result is a vertical pedestal pulse on the retrace base line located at the extreme right-hand side of the oscilloscope display. The pulse amplitude indicates the RF level program.

FREQUENCY INDICATOR PULSE CIRCUITRY

The tuning program at pin 6 is inverted by operational amplifier IC4B where it offsets the adjusted triangle wave from pin 4, and the inverted program is fed to the inverting input of comparator IC4A. Freq Ind Range control R28 adjusts the amplitude of the triangle waveform, and Freq Ind Cent control R31 adjusts the offset level at the comparison point. The comparator output is a positive pulse starting and terminating at the points in time when the adjusted offset triangle wave is greater than the zero volt reference.

The output of comparator IC4A is differentiated by C15 and R38, and combined with the demodulated output through R40. The frequency indicator appears only on the retrace base line as a narrow differentiated pulse that moves across the base line in step with the tuning program.

3.12 PROGRAMMER OVERVIEW

Refer to Figure 3-2.

The programmer consists of five PC assemblies: the Front Panel board, the Mother Board, the Counter/Display Driver card, the Memory card, and the Frequency Control card; and two module assemblies: the SPM636 Phase Lock module and a second SPM656 Sweep Oscillator module. The PC assemblies perform the digital selection and coding of the selected channel, while the two modules form a phase-locked CW signal source to precisely tune the sweep generator RF output frequency.

Power is supplied to the programmer via the sweep generator's REMOTE jack

and interconnecting harness. The programmer's +12 V and +5 V supplies are drawn from the sweep generator's +18 V source.

3.13 FRONT PANEL AND MOTHER BOARDS

The Front Panel board contains the UP/DOWN, SELECT, and RESET pushbutton switches, and the CHANNEL display. These are connected by two ribbon cables to the Mother board, into which the Counter/Display Driver, Memory, and Frequency Control cards are plugged.

3.14 COUNTER/DISPLAY DRIVER CARD

The main counter is an eight-bit binary up/down counter comprised of IC4 and IC5. When reset, the output goes to 00000000. Whether the counter counts up or down is determined by the D-type flip-flop IC2, set by the UP/DOWN pushbutton. The main counter is triggered by the SELECT pushbutton. When this button is held down for 1/2 second, a timer is enabled, triggering the main counter at a 4 Hz rate.

The output of the main counter is the count code. The most significant bit of this code is sent to four-input NOR gate IC3A. The NOR gate combines this bit, the memory reset from the Memory card, and the front-panel RESET pushbutton. Any of these can reset the main counter. When reset, the main counter transfers zero, which is at the input to the counter, to the output. The up/down, clock, and reset lines are also connected to the display counter IC6 and IC7. This counter counts along with the main counter, resets at the same time, and counts in the same direction, but counts in BCD and resets to one. The outputs are sent to decoders IC12 and IC13 to drive the CHANNEL display.

3.15 MEMORY CARD

The count code is the input to customer memory IC1. This memory converts the count code to a channel code, and is programmed according to customer requirements. Program Select switch S1 allows the customer to address up to eight different 99-location blocks in the memory to provide eight channel sequences. The four most significant output bits are connected to IC2, which is wired as an AND gate. The output of IC2 is then connected to the reset circuit on the Counter/Display Driver Card so that the memory can be programmed to reset automatically after any length sequence.

3.16 FREQUENCY CONTROL CARD

The channel code is connected to the DAC memory, IC1. The DAC memory contains the correct code for the frequency control voltage produced by DAC IC3. This coarse tuning voltage is aided by an automatic marker locking circuit which samples the horizontal drive voltage during the time that the markers appear on the scope display. These two voltages are then added together, and the resulting voltage is held to zero by an error correction circuit added into the frequency control voltage.

3.17 PHASE LOCK (SPM636)

Refer to Figure 3-3.
The SPM636 Phase Lock module and a second SPM656 Sweep Oscillator module (see Section 3.5) together make up a programmable phase-locked CW signal source. The SPM636 module contains all the circuitry needed to phase lock the oscillator to any user-specified frequency between 1 and 500 MHz in 250 kHz increments.

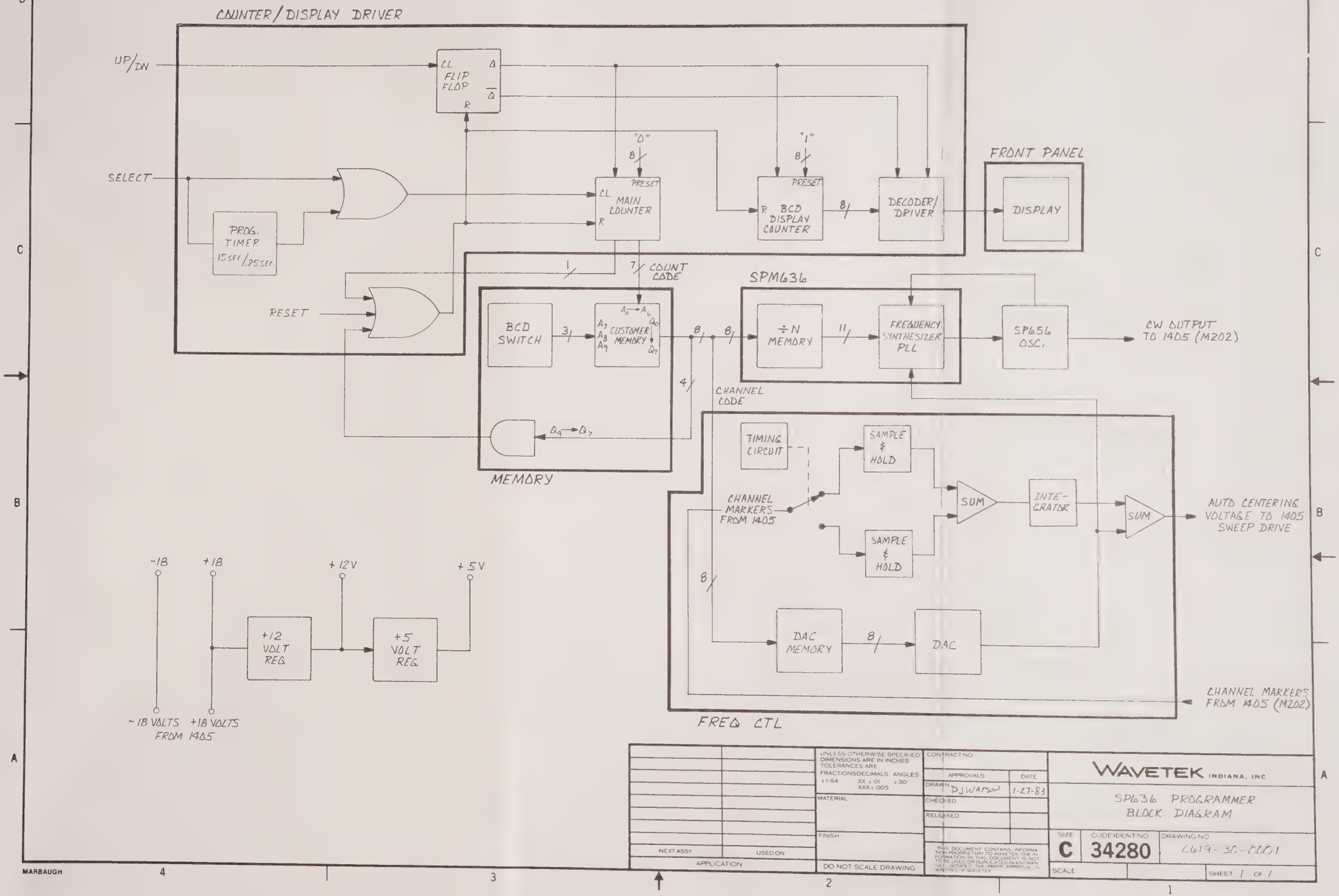
The channel code from the Memory card is connected to divide-by-N memory IC4/IC5, which decodes the input to provide the correct divider (N) for frequency synthesizer IC3 (Fout/ 250,000 = N).

The RF output of the SPM656 is fed to the input of IC1 in the SPM636. IC1 is a modulus-two prescaler, and IC2 is a dual D flip-flop. IC1 and IC2 are connected to form a divide-by-32 prescaler. The TTL output from IC1 pin 7 is then fed to IC3.

IC3 is a CMOS PLL frequency synthesizer consisting of a reference oscillator, selectable reference divider, digital phase detector, and a 14-bit programmable divide-by-N counter. The prescaled RF signal from the SPM656 is fed to the divide-by-N counter. The output of the divide-by-N counter is fed to one input of the digital phase detector. The other input to the phase detector is a 7812.5 Hz signal which is derived from 2 MHz crystal reference oscillator X1 divided by 256 by the reference divider. Under locked conditions, both inputs to the phase detector will be 7812.5 Hz, and in phase. The output of the phase detector is then connected to a low-pass loop filter which controls the basic loop characteristics such as capture range, capture time, loop bandwidth, and transient response. The loop filter is made up of IC6B and its associated components. The filter takes the pulses from the output of the phase detector, integrates them, and outputs a correction voltage. This correction voltage is amplified and summed with the coarse tuning voltage from the Frequency Control card by IC6A, inverted by IC7A, and output at module pin 7 to control the frequency of the SPM656 Sweep Oscillator module. The Offset and Gain adjustments scale the combined correction voltage to the proper level for use by the SPM656.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

Figure 3-2. Programmer Block Diagram



NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ±1/64 DECIMALS XX ± .01 XXX ± .005 ANGLES ±30'	CONTRACT NO	WAVETEK INDIANA, INC
APPLICATION		MATERIAL	APPROVALS / DATE	SP636 PROGRAMMER BLOCK DIAGRAM
		FINISH	DRAWN DJWATSON 1-27-83	SIZE C · CODE IDENT NO 34280 · DRAWING NO 0619-30-0001
		DO NOT SCALE DRAWING	CHECKED / RELEASED	SCALE · SHEET 1 OF 1

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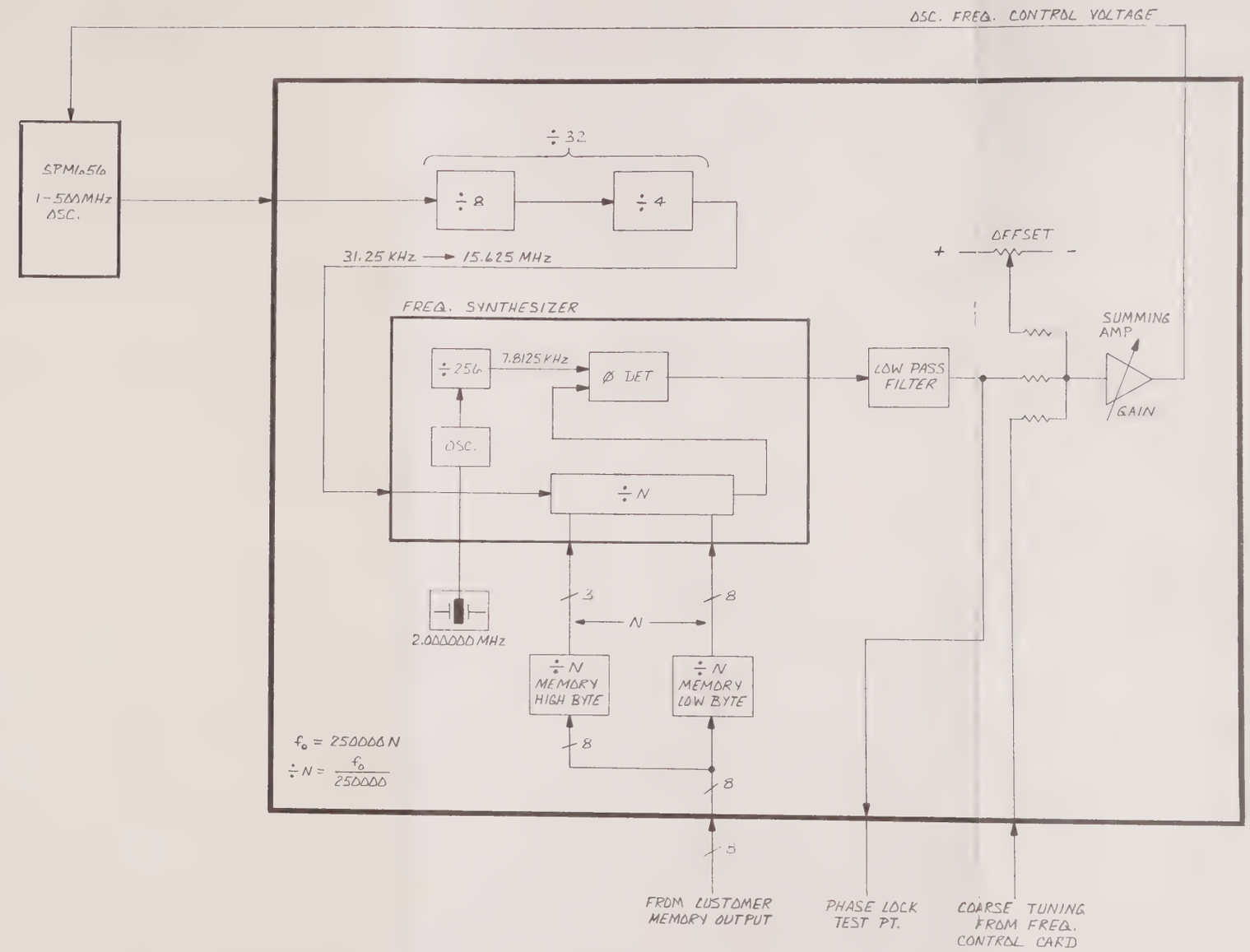
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

Figure 3-3. SPM636 Block Diagram



NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS ±1/64 DECIMALS XX ± .01 XXX ± .005 ANGLES ±30'	CONTRACT NO	WAVETEK INDIANA INC
APPLICATION		MATERIAL	APPROVALS DATE	SPM636 PHASE LOCK MOD. BLOCK DIA.
		FINISH	DRAWN DJ NITZ 3-16-83	SIZE C · CODE IDENT NO 34280 · DRAWING NO ΔΔM-3Δ-ΔΔΔ3
		DO NOT SCALE DRAWING	CHECKED	SCALE · SHEET 1 OF 1
			RELEASED	

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4.1 INTRODUCTION

This section provides information for testing, calibrating, and troubleshooting the instrument. The performance tests are designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and troubleshooting sections.

4.2 SERVICE INFORMATION

4.2.1 PROGRAMMER/SWEEP GENERATOR SEPARATION

To separate the programmer and sweep generator sections, first remove the two screws at the rear of the programmer top cover. Remove the top cover by lifting it off with a slight rearward movement. Remove the two screws accessible through the holes at the front of the programmer chassis. Slide the entire programmer section rearward and lift the programmer from the sweep generator section.

To rejoin the two sections, slide the programmer forward such that the U-shaped bracket on the programmer bottom cover "catches" the bushing on the sweep generator top cover. Replace the two screws through the holes in the programmer chassis and replace and secure the programmer top cover.

4.2.2 PROGRAMMER DISASSEMBLY

The programmer top and bottom covers can be removed by removing the two screws at the rear of each cover and lifting each cover off with a slight rearward movement. Each side panel can be removed by removing the four screws securing the side panel and lifting the side panel off.

4.2.3 SWEEP GENERATOR/DISASSEMBLY INFORMATION

To remove the sweep generator bottom cover, remove the screws holding the two rear feet and lift the cover off with a slight rearward movement.

To remove the top cover, remove the single screw and bushing from the top and lift the cover off with a slight rearward movement.

Either side panel can be removed to provide better access by removing the four screws holding the side panel to the instrument. The front panel/module section can be removed from the power supply section by removing the two screws holding the sections together and disconnecting the electrical connectors between the two sections.

NOTE

Separation of the two sections performs no useful purpose during normal service procedures.

4.2.4 MODULE SERVICING

Modules may be removed by removing any cables attached to the top of the module and removing the hold-down screw from the bottom.

To remove the module cover, remove all nuts and screws from top of the module and slide the cover off.

The module pins are numbered as shown in Figure 4-1. The index studs for the circuit modules are located off center to prevent the module's being plugged in backwards. This off-center stud location also provides a method for locating pin 1.

Before reinstalling the module, check the module pins for proper alignment, then carefully seat the module pins into the chassis socket and replace the hold-down screw to ensure a good ground connection between module and chassis.

NOTE

Service Kit K102 contains a module extender and RF extension cables which enable a module to be electrically operated while physically located above the rest of the modules, thereby making all parts easily accessible.

4.2.5 PC BOARD SERVICING

There are four printed-circuit assemblies in the programmer section, the front-panel board and the three plug-in cards at the rear of the programmer. To remove one of the three plug-in cards, remove the two knurled screws securing the access plate on the programmer rear panel. Grasp the card firmly and slide it out of its guide/holder. To reinstall a card, align the card in its guide/holder and carefully slide it forward until it seats firmely in its socket.

CAUTION

There are static sensitive components on each of the three plug-in cards.

To remove the front-panel board, remove the programmer top cover, right side panel, and the two modules. Remove the six nylon screws securing the board to the front panel. Disconnect the two ribbon cable assemblies and lift the board from the programmer. The board is reinstalled by reversing the removal procedure.

4.3 PERFORMANCE TEST

4.3.1 INTRODUCTION

The purpose of the performance tests in this Section is to verify that the Model 1405 meets its published specifications (Section 1.2). Individual performance tests consist of the specification to be verified, a list of equipment required, and a detailed test procedure including, in some cases, a simplified setup drawing.

Before applying power to the instrument, see Section 2 for details of electrical installation. The line voltage should be maintained at 115 or 230 VAC, $\pm$10%, 50 or 60 Hz throughout the tests. The performance test procedures are begun after a 15 minute warmup of the instrument in +20° to +30° C ambient temperature.

A copy of the Performance Test Record (PTR) is provided at the end of this section for convenience in recording the performance of the Model 1405 during testing. It can be filled out and used as a permanent record for incoming inspection, or it can be used as a guide for routine performance testing. The PTR lists the section, test, specification, and results.

NOTE

In all tests, the AUTO switch should be in its down position.

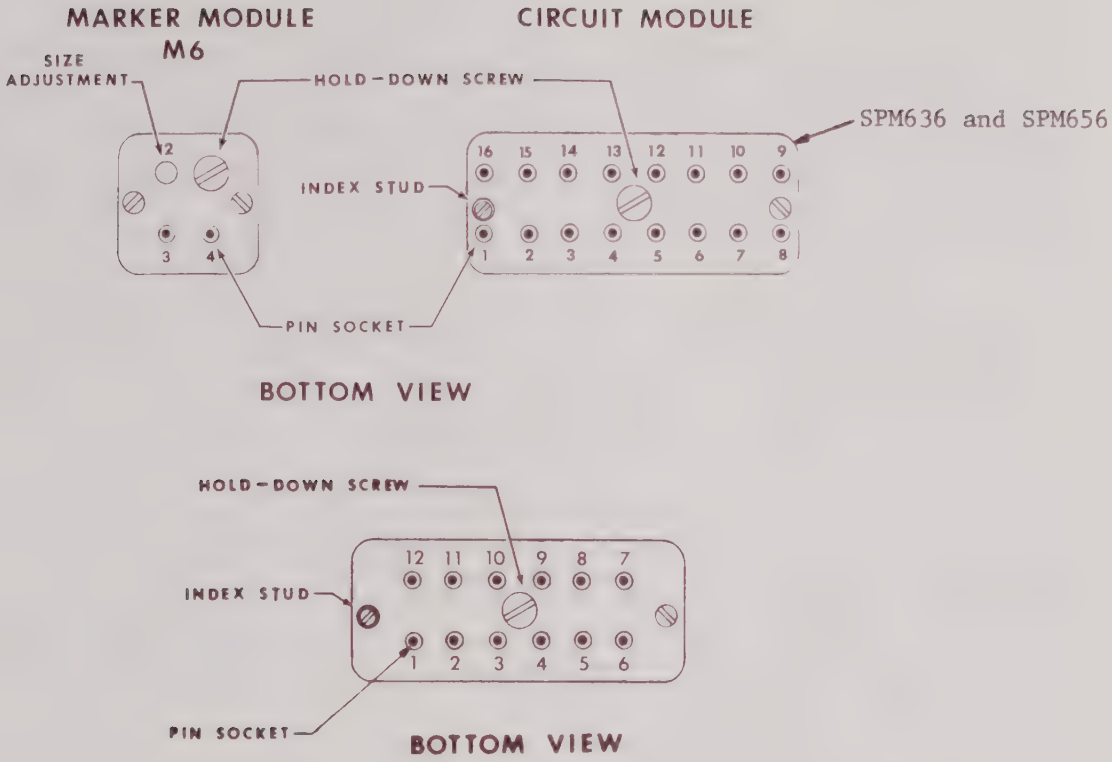


Figure 4-1. Module Pin Numbering

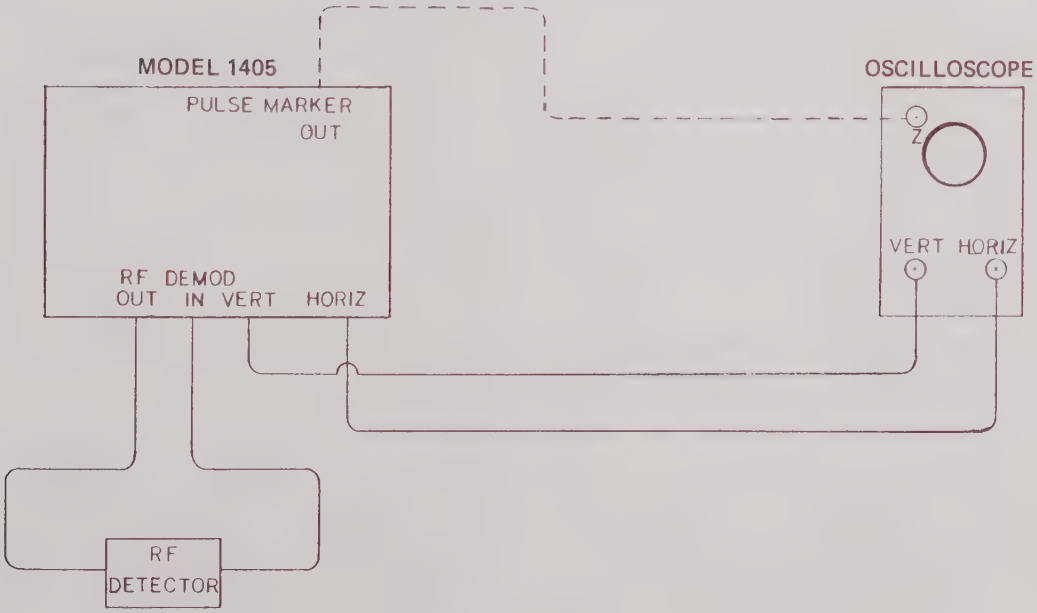


Figure 4-2. Test Set-up

Table 4-1. Recommended Test Equipment for Performance Tests

INSTRUMENT	REQUIREMENT	RECOMMENDED
(1) 75 ohm RF Detector	1 to 500 MHz	Wavetek Model D171
(2) Oscilloscope	Horiz time base and X-Y operation	Tektronix Model T922
(3) Marker Generator	1 and 50 MHz Harmonic	Wavetek Model SP298
(4) Signal Generator	Accuracy $\pm$.001% range 10 to 500 MHz resolution 10 kHz	Wavetek Model 3000
(5) Matching Pad	75 to 50 ohm BNC	Wavetek Model M175 (loss = 5.7 dB)
(6) Spectrum Analyzer	1 to 10 MHz	H.P. Model 182T Oscillator with Model 8558B Spectrum Analyzer plug-in head

Table 4-2. Additional Recommended Test Equipment For Calibration

INSTRUMENT	REQUIREMENT	RECOMMENDED
(7) 50 ohm RF Detector	1 to 500 MHz	Wavetek Model D151
(8) Frequency Counter	1 to 500 MHz	Wavetek Model CM-1000
(9) Digital Voltmeter	0.1% Accuracy	Keithley 179

4.3.2 SCOPE HORIZONTAL OUTPUT

SPECIFICATION -8 to +8 V triangle waveform, ±.2 V.

EQUIPMENT (2)

PROCEDURE - Connect the Model 1405 SCOPE HORIZ connector to the oscilloscope vertical input. Adjust the oscilloscope internal time base, vertical sensitivity, and triggering for a stable trianle waveform. Record the amplitude on the PTR. Note that the trace (positive slope) and retrace (negative slope) are each approximately 8.3 msec (for 60 Hz line rate) or 10 msec (for 50 Hz line rate) duration.

4.3.3 MAXIMUM SWEEP WIDTH

SPECIFICATION 500 MHz

EQUIPMENT (1) (2) (3)

PROCEDURE - Connect the equipment as shown in Figure 4-3. In manual mode, set the FREQUENCY control to 250 MHz. Turn on the 50 MHz harmonic markers. Attenuate the Model 1405 RF output by approximately 15 dB to eliminate marker distortion. Identify the 0 MHz (zero beat) and 500 MHz markers. Turn on the 1 MHz harmonic markers and record the maximum sweep width on the PTR.

4.3.4 LINEARITY

SPECIFICATION ± 2%

EQUIPMENT (1) (2) (3)

PROCEDURE - Connect the equipment as shown in Figure 4-3. In manual mode, set the FREQUENCY control to 250 MHz. Turn on the 50 MHz harmonic markers. Attenuate the Model 1405 RF output by approximately 15 dB to eliminate marker distortion. Identify the 0 MHz (zero beat) and 500 MHz markers, and adjust the SWEEP WIDTH and oscilloscope horizontal position controls such that the 0 MHz marker is aligned with the left-most oscilloscope graticule line and the 500 MHz marker is aligned with the right-most graticule line. Each 50 MHz marker should fall within 0.2 major division of a graticule line. If so, place a check mark on the PTR.

4.3.5 FREQUENCY DIAL ACCURACY

SPECIFICATION ± 20 MHz

EQUIPMENT (1) (2) (3)

Using the set-up of Section 4.3.4, set the FREQUENCY control to precisely 250 MHz. The 250 MHz marker must now be within 0.4 major divisions of the center graticule line. Set the FREQUENCY control precisely to each 50 MHz interval mark on the FREQUENCY dial and note the deviation of the appropriate marker from the center graticule line. If each appropriate marker is within 0.4 major divisions of the center graticule line, place a check mark on the PTR.

4.3.6 MINIMUM SWEEP WIDTH

SPECIFICATION 1 MHz

EQUIPMENT (1) (2) (3)

PROCEDURE - Connect the equipment as shown in Figure 4-3. Turn on the 1 MHz harmonic markers. Reduce the sweep width to minimum and record the wide minimum sweep width on the PTR.

Pull the SWEEP WIDTH knob out for narrow minimum sweep width and record the narrow minimum sweep width on the PTR.

4.3.7 TUNING RANGE

SPECIFICATION < 1 to > 500 MHz

EQUIPMENT (1) (2) (3)

PROCEDURE - Connect the equipment as shown in Figure 4-3. Turn on the 50 MHz

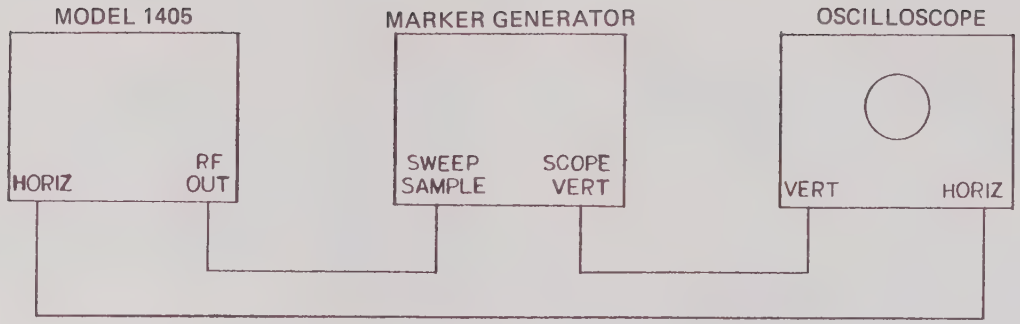


Figure 4-3. Test Set-up

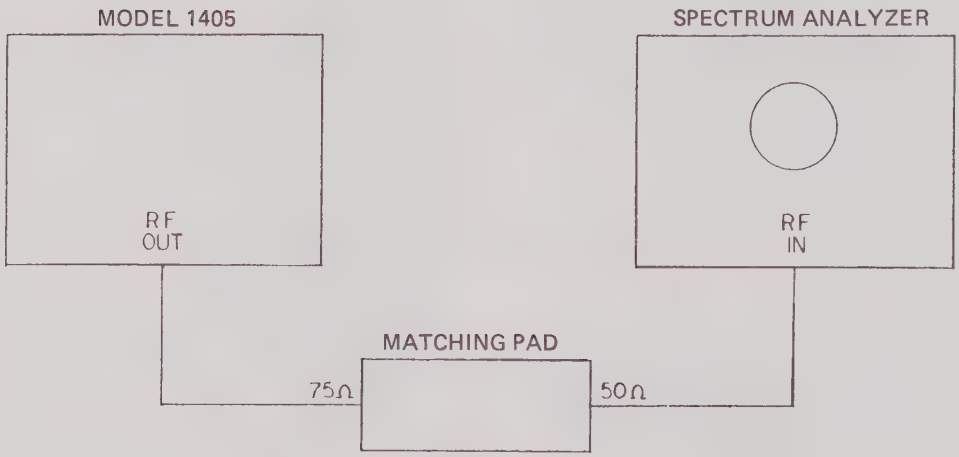


Figure 4-4. Test Set-up

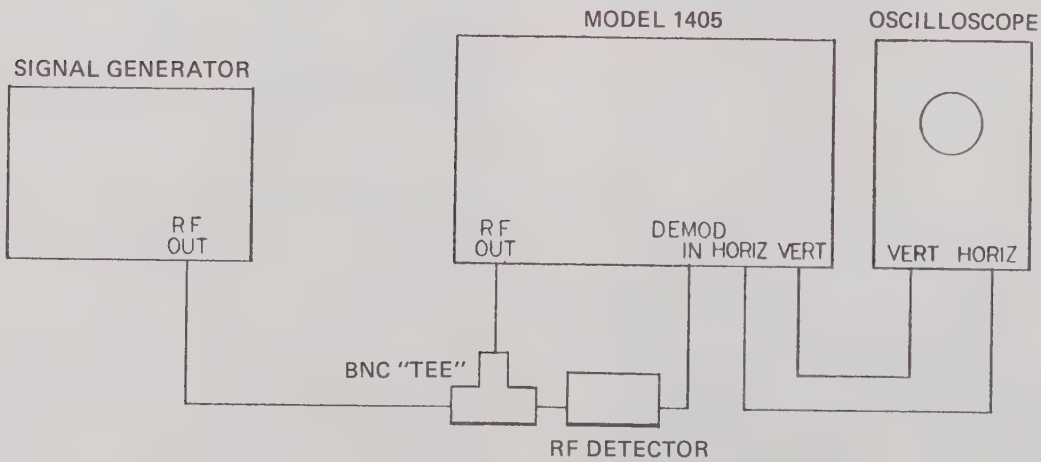


Figure 4-5. Test Set-up

and 1 MHz harmonic markers. In manual mode, tune the FREQUENCY control throughout its range and record the tuning range as identified by the markers. Record the range extremes on the PTR.

4.3.8 MAXIMUM OUTPUT

SPECIFICATION > +57 dBmV (0.708 VRMS)

EQUIPMENT (1) (2)

PROCEDURE - Connect the equipment as shown in Figure 4-2. In manual mode, set the STEP ATTENUATOR to 0, the FREQUENCY control to 250 MHz, and the SWEEP WIDTH control fully cw. +57 dBmV is indicated by and RF detector output of approximately 0.8 VDC. Record the detected output (must be > 0.75 VDC) on the PTR.

NOTE

RF detector characteristics limit the resolution of this method to ±0.5 dB. If greater resolution is desired, a spectrum analyzer or power meter can be used with a matching pad to measure RF output power.

4.3.9 IMPEDANCE

SPECIFICATION 75 ohms ± 1%

EQUIPMENT (1) (2)

PROCEDURE - Connect the equipment as shown in Figure 4-2. Insert a BNC "T" at the RF OUT connector. Note the detected output.

Add a 75 ohm termination to the open port of the BNC "T". The detected output should drop to 67 ± 3% of the previous value. Record the drop on the PTR.

NOTE

Because of RF detector characteristics, etc., the resolution of this method is approximately ± 3%; however, this resolution should be adequate for most applications.

4.3.10 FLATNESS

SPECIFICATION ±0.25 dB from 1 to 500 MHz

EQUIPMENT (1) (2)

PROCEDURE - Connect the equipment as shown in Figure 4-2. In manual mode, set the STEP ATTENUATOR to 0, the FREQUENCY control to 250 MHz, and SWEEP WIDTH control fully cw. Note the maximum output peak on the oscilloscope. The flatness specification of ±0.25 dB corresponds to an output "droop" of less that 6% below the maximum output peak. Record the "droop" on the PTR.

4.3.11 ATTENUATION

NOTE

There are two attenuators in the RF output path of the Model 1405. The VERNIER ATTENUATOR is continuously adjustable from 0 to 20 dB, but is not calibrated. The fixed-pad 35 dB STEP ATTENUATOR is calibrated every 5 dB.

SPECIFICATION ±0.5 dB at any frequency from 1 to 500 MHz.

EQUIPMENT (5) (6)

PROCEDURE - Connect the equipment as shown in Figure 4-4. In manual mode, set the FREQUENCY control as desired. Set the VERNIER ATTENUATOR fully cw. Set the SWEEP WIDTH control fully ccw and pull for narrow. Set the trigger on the spectrum analyzer for line. Sequence through the STEP ATTENUATOR steps and record the maximum deviation from the nominal output on the PTR.

Turn the VERNIER ATTENUATOR fully ccw and record the range on the PTR.

4.3.12 PULSE MARKERS

SPECIFICATIONS

PRESENTATION - differentiated pulses at SCOPE VERT connector. Positive or negative pulses at PULSE MARKER OUTPUT connector (with jumper installed).
SIZE - 0 to 8 Vpp at SCOPE VERT connector.
0 to ±30 V at PULSE MARKER OUTPUT connector (with jumper installed).
WIDTH - approximately 1% of horizontal display.
ACCURACY - ±0.02% (+25 kHz-0 Hz) at pulse leading edge.

EQUIPMENT (1) (2) (4)

PROCEDURE - Connect the equipment as shown in Figure 4-2. Set the PGM switch to its up position. Rotate the front-panel MARKER SIZE control and record the range of pulse amplitude on the PTR.

To route the carrier marker pulses to the rear-panel PULSE MARKER OUTPUT connector, install a jumper wire on the sweep generator chassis between pins 5 and 6 of the M7E module socket. Set the PULSE MARKER SIZE switch to +. Connect the oscilloscope's vertical input to the PULSE MARKER OUTPUT connector. If Option B is installed, identify the differentiated carrier marker pulses. Rotate the PULSE MARKER SIZE control and record the range of pulse amplitude on the PTR. Set the PULSE MARKER switch to - and again rotate the rear-panel PULSE MARKER SIZE control and record the range of the pulse amplitude on the PTR.

Set the PULSE MARKER SIZE switch to +. Identify the uni-polar marker pulses. Rotate the rear-panel PULSE MARKER SIZE control and record the range of the pulse amplitude. Set the PULSE MARKER switch to - and again rotate the rear-panel PULSE MARKER SIZE control and record the range of the pulse amplitude on the PTR.

Remove the jumper and reconnect the oscilloscope's vertical input to the SCOPE VERT connector. Calibrate the oscilloscope horizontal axis to 1 MHz/major division by reducing the sweep width until the carrier marker pulses are 4.5 major divisions apart. The carrier maker pulses should be less that 0.1 major divisions wide. If they are, place a check on the PTR.

Connect the equipment as shown in Figure 4-5. Set the programmer for the desired channel. Set the sweep width to 10 MHz, and the signal generator for a -15 dBm CW signal.

Expand the oscilloscope horizontal axis by 10x for better resolution. Set the signal generator frequency such that the small RF-beat birdy is evenly divided by the leading edge of the carrier marker pulse.

Record the marker accuracy on the PTR.

NOTE

The resolution of this method is no better that ±20 kHz, which is of the same order as the marker accuracy specification; however, this resolution should be adequate for most applications.

4.3.13 PROGRAMMER LOCK

SPECIFICATION: Maintain frequency lock at 10 MHz sweep width.

EQUIPMENT (1) (2)

PROCEDURE - Connect the equipment as shown in Figure 4-2. Set the PGM switch to its up position. Adjust the SWEEP WIDTH control such that the pulse markers are evenly spaced about the center graticule line on the oscilloscope display, and are 4.5 major

divisions apart. Using the programmer SELECT button, sequence the programmer through all channels. The marker positions should vary < 0.2 major divisions at each channel. If so, place a check on the PTR.

NOTE

When applying power, adjustment of the SWEEP WIDTH control may be necessary to regain frequency lock.

4.4 CALIBRATION PROCEDURE

Separate the programmer and sweep generator sections. Remove the top and bottom covers from the sweep generator section and M2E-1 module cover. Tune the instrument on and allow a 15 minute warm-up period before calibrating.

In general, calibration must be performed in the sequence given.

4.4.1 +18 VOLT ADJUSTMENT

Connect a digital voltmeter (DVM) to the +18 volt supply (pin 6 on power supply plug P2) and adjust R9 (see Figure 4-6) for a +18 ±10 mV DVM reading.

4.4.2 -18 VOLT CHECK

Connect the DVM to the -18 volt supply (pin 4 on power supply plug P2). The -18 volt supply is designed to track the +18 volt supply, and no independent adjustment is provided. The DVM should read -18 V ±50 mv.

4.4.3 HORIZ SIZE ADJUSTMENT

Adjust the oscilloscope to operate in an X-Y mode with DC coupling on both the vertical and horizontal inputs. Adjust the oscilloscope's horizontal sensitivity to exactly 2 V/division (use the previously calibrated ±18 volt supplies to calibrate the horizontal sensitivity). With no horizontal input to the oscilloscope, position the dot to the exact center of the display.

Connect the SCOPE HORIZ connector to the oscilloscope horizontal input. Adjust R26 (see Figure 4-6) to produce a horizontal line on the display of -8 to +8 volts as shown in Figure 4-7. (An offset either way of 0.2 V is acceptable.)

4.4.4 MODULE M2E-3 SIZE AND CENT ADJUSTMENT

Using the set-up of Section 4.43, connect pin 1 of module M2E-3 (FREQUENCY control wiper) to the oscilloscope vertical input. Adjust the FREQUENCY control for a 0 ±5 mV reading on the oscilloscope. This should correspond to the 250 MHz FREQUENCY control setting. Connect the oscilloscope vertical input to TP 1 in the M2E-3 module (see Figure 4-8). Set the SWEEP WIDTH control fully cw. Set the oscilloscope's vertical sensitivity to 5 V/division and adjust M2E-3 control B (Size) and control A (Centering) to obtain a +14 to -14 volt signal centered about zero volts (see Figure 4-9).

4.4.5 MODULE SPM656 (SWEEP GENERATOR) CENTERING ADJUSTMENT

Connect the equipment as shown in Figure 4-3. Set the oscilloscope's vertical sensitivity for 0.2 V/division and the oscilloscope's horizontal sensitivity for a display pattern 10 divisions wide. Attenuate the Model 1405 output by 15 dB to eliminate marker distortion. Be sure the AUTO switch is down. Set the SWEEP WIDTH control fully cw and the FREQUENCY control to 250 MHz.

Turn on the 50 MHz harmonic markers. Set the fifth (250 MHz) marker to the exact center of the display (see Figure 4-10) with the SPM 656 Centering control.

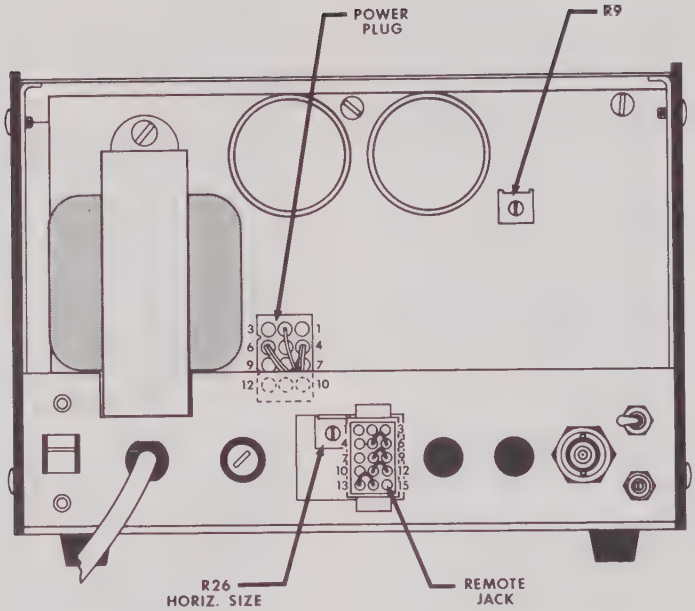


Figure 4-6. PS7 Rear View

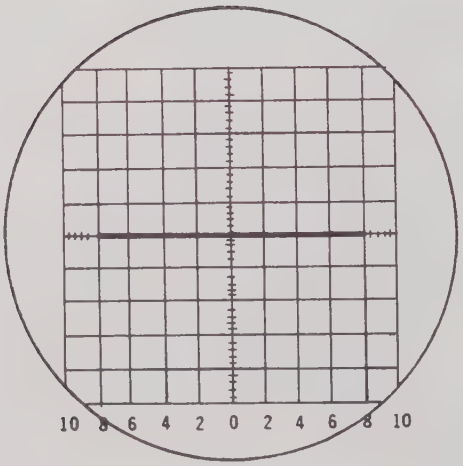


Figure 4-7. PS7 Horiz Size

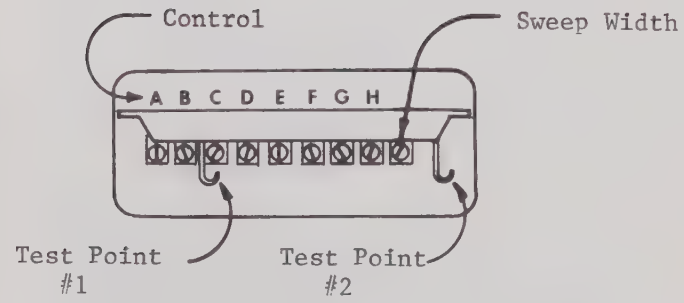


Figure 4-8. M2E-3 Control Locations

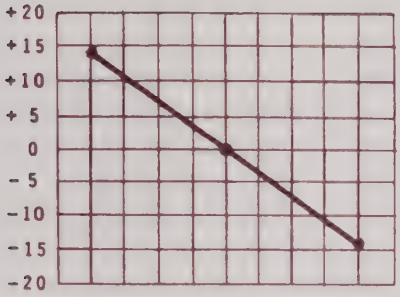


Figure 4-9. M2E-3 Size/Cent

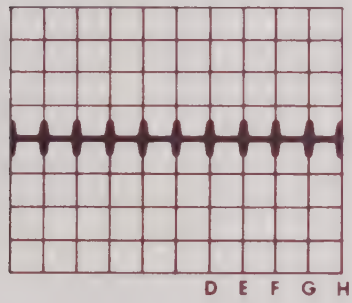


Figure 4-10. M2E-3 Centering/Linearity

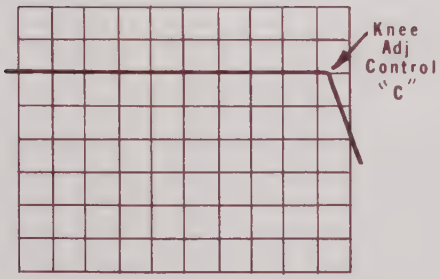


Figure 4-11. M2E-3 Lin Ref

4.4.6 MODULE M2E-3 SWEEP WIDTH/ LINEARITY ADJUSTMENTS

Using the final set-up of Section 4.4.5, adjust the M2E-3 Sweep Width limit control (see Figure 4-8) to align the 0 MHz marker (zero beat) with the left-most oscilloscope graticule line (see Figure 4-10).

Connect the oscilloscope vertical input to TP 2 of the M2E-3 module (see Figure 4-8) and adjust control C (Linearity Reference) to position the "knee" just to the right of the 9th oscilloscope graticule line as shown in Figure 4-11.

Connect the oscilloscope vertical input to the instrument SCOPE VERT connector. The SPM656 Sweep Oscillator is inherently linear from 0 to 250 MHz. Five adjustments are provided to improve the linearity from 250 to 500 MHz. The 50 MHz harmonic markers are used in setting the linearity. Control D (see Figure 4-8) adjusts the 300 MHz marker. Control E adjusts the 350 MHz marker. Control F adjusts the 400 MHz marker. Control G adjusts the 450 MHz marker. Control H adjusts the 500 MHz marker. Adjust controls E through H to align each marker with its corresponding oscilloscope graticule line as shown in Figure 4-10. Adjustments must be made in the sequence given.

4.4.7 MODULE SPM656 (SWEEP GENERATOR MIN AND MAX LEVEL ADJUSTMENTS

Set up equipment as in Figure 4-2. Adjust the SPM656 Level Max control to produce an oscilloscope pattern amplitude of 0.8 volts when the front-panel VERNIER ATTENUATOR is set fully cw (this is equivalent to an output of 0.7 VRMS). Next, set the front-panel VERNIER ATTENUATOR control fully ccw and adjust the Level Min control to produce an oscilloscope pattern of 40 millivots. Some interaction exists between the Level Min and Max adjustments, so repeat the adjustments until the 40 millivolt and 0.8 volt patterns are obtained without further adjustment. The accuracy of the above procedure is dependent on the RF detector, which is generally adequate. If more accuracy is required, an RF power meter can be substituted for the detector.

4.4.8 M202 SWEEP SAMPLE LEVEL ADJUSTMENT

Using the final set-up of Section 4.4.6, connect a 50 ohm RF detector (Wavetek Model D151 or equivalent) to the M202 Sweep Sample Out connector. Connect the detected output to the oscilloscope vertical input and set the oscilloscope vertical sensitivity to 10 mV/division. Adjust the M202 proximately 30 mV of leveled sweep sample. Remove the RF detector.

4.4.9 FREQUENCY CONTROL CARD ADJUSTMENTS

Turn unit power off and remove frequency control card (lower card in programmer). Move jumper to right hand position. Reinstall card and set up equipment so that 1405 horizontal and vertical outputs are connected to the X and Y inputs of the oscilloscope, RF out is connected to a Wavetek D171 or equivalent RF Detector and the output of the detector is connected to the 1405 Demod input.

Set PGM switch to its up position and adjust the sweep width control so that one set of pulse markers appear near the center of the display approximately one division apart. Using the channel select switch, step through all channel frequencies while observing pulse markers on scope. Adjust the coarse tuning range control (refer to section 2.5.2) so that the amount the pulse markers deviate from center is

minimized. (It may be necessary to step through the channels several times). Move the Frequency Control Card jumper back to the left width control so that one pair of pulse markers appear on the scope display approximately 4.5 divisions apart. Adjust the marker centering control so that the markers are evenly spaced about the center of the scope display.

4.410 PHASE LOCK MODULE ADJUSTMENTS

Remove cover from the SPM636 Phase Lock Module in the programmer. Connect a 1 to 500 MHz frequency counter to the unused sweep sample output jack on the SPM656 oscillator module in the programmer. Connect a digital voltmeter to pin 5 of the SPM636 Phase Lock Module. This is the phase lock voltage test point.

Refer to unit program sheet and set programmer for minimum frequency. Observe test point voltage and oscillator frequency. Oscillator frequency should be the channel center frequency (video carrier frequency +2.25 MHz for 4.5 MHz sound-video spacing). There are three potentiometers on the SPM636 phase lock module PC board. The upper left is the offset adjustment and the lower is the gain adjustment. At the frequency set above, adjust the gain pot for minimum voltage at the phase lock test point. Set programmer to a channel near 250 MHz. Adjust the offset pot to minimize the phase lock test point voltage. Set programmer to the highest frequency possible and observe the test point voltage. If the voltage is greater than ± 5 volts DC, re-adjust the gain pot. Program through all channels to verify that all frequencies are correct and that the phase lock test point voltage does not become greater than ± 5 VDC (readjustment of gain and offset may be necessary). Connect an oscilloscope probe to the phase lock module pin 5 and set scope vertical sensitivity to 10 milivolts and AC couple. Observe waveform on scope and adjust upper right hand pot on the Phase Lock Module to Null out the 7.8 KHz signal riding on the waveform.

4.5 TROUBLESHOOTING

Effective troublshooting requires a thorough understanding of the block diagram and circuit description located in Section 3 of this manual. The Performance Tests and Calibration Procedures in Section 4 will aid in localizing the trouble symptom to a particular subassembly. Once this has been accomplished, the subassembly can be replaced, or repaired with the aid of the proper schematic. In general, it is preferable to replace a defective subassembly.

Equipment troubles are frequently due simply to improper control settings; therefore, before engaging in a troubleshooting procedure, be sure all front-panel controls are set in proper operating position. Refer to the Operating Instructions in Section 2 of this manual for a complete explanation of each control's function, along with typical operating instructions.

After verifying that the trouble is not improper setting of the controls or test set-up, make a thorough visual inspection of the instrument for such obvious defects as loose or missing screws, broken wires, defective module-pin sockets, loose RF cables, and burned or broken components.

After localizing the problem, voltage and resistance checks will help find the defective component.

For troubleshooting purposes, it is permissible to operate the Model 1405 with any of the subassemblies, ribbon

cables, or RF cable removed; however, the instrument should be turned off when removing or installing subassemblies. If substitute subassemblies are available, possibly from another Model 1405, this provides an easy method of verifying if a suspected subassembly is defective.

RF cables can be disconnected from the module output connectors and a power meter or spectrum analyzer connected directly to the module connector for power level or frequency measurements. Fabrication of a short coax adapter cable, terminated in a mating connector, for the modules on one end and a BNC connector on the other, will facilitate connection of test equipment.

A problem in a power supply may cause many symptoms pointing to other areas, and should be checked when the symptom does not indicate a specific problem.

4.5.1 TROUBLESHOOTING HINTS

Following is a list of several typical symptoms, accompanied by the possible cause(s) or a troubleshooting procedure. It is assumed the instrument has been properly calibrated previously, and that a warmup period will precede troublshooting.

+18 V OUT OF CALIBRATION - If the +18 V supply measures over +25 V, change the regulator, IC1. If the ±18 V supplies measure low, disconnect the power jack, J2, from the PS7 power supply and carefully check for ±18 V at plug P2. If the ±18 V supplies are now correct, low voltage was due to over-current limiting by the power supply. Reconnect J2 to P2 and unplug subassemblies until the overload is found.

INTERMITTENT OPERATION - Check for loose RF cables or loose modules. If none, check for defective module pin sockets.

NO HORIZONTAL OUTPUT - Check pin 8 of power plug P2 for a ±18 V triangle wave. If none, check the ±18 V supplies.

NO RF OUTPUT - Use an RF detector to check the outputs of module SPM656 in the sweep generator section.

FREQUENCY INSTABILITY - Check hold-down screws beneath modules M202 and SPM656 in the sweep generator section. Check for a stable sweep drive voltage from module M202 at pin 9. Ensure that the ±18 V supply voltages have less than 5 mV ripple.

UNFLAT RF OUTPUT - Check for a defective RF detector. Reduce the RF output with VERNIER ATTENUATOR to see if the RF output notches flatten out. If they do not, check RF output cables. If they do, check module SPM656 in the sweep generator section for sufficient RF output (30 mV into a 50 ohm detector).

NO SCOPE VERT OUTPUT - Check for at least a 10 mV amplitude DC signal into the DEMOD IN connector. If present, the trouble is probably in module M8E-1 (Option C).

UNSTABLE BASELINE - Check module M8 or M8E-1 (Option C) for good ground.

PROGRAMMER NOT OPERATING - Check that the footswitch is connected to the rear-panel FOOTSWITCH connector.

NO MARKERS OR WEAK MARKERS - Check for sufficient output from module SPM656 in the programmer section (30 mV into 50 ohm detector).

MARKERS NOT OPERATING CORRECTLY Check for defective module SPM636.

PERFORMANCE TEST RECORD

DATE_____

MODEL 1405

S.N._____

SECTION	TEST	SPECIFICATION	RESULTS
4.3.2	Scope Horizontal Output	-8 to +8 V, ±2 V	-_____V to +_____V
4.3.3	Maximum Sweep Width	≥ 500 MHz	_____MHz
4.3.4	Linearity	± 2%	_____check
4.3.5	Freq. Dial Accuracy	± 20 MHz	_____check
4.3.6	Minimum Sweep Width		
	Wide	≤ 1 MHz	_____MHz
	Narrow	≤ 1 MHz	_____MHz
4.3.7	Tuning Range	< 1 to > 500 MHz	_____MHz
4.3.8	Maximum Output	> 0.75 VDC	_____MHz
4.3.9	Impedance	60 - 70%	_____%
4.3.10	Flatness	< 6%	_____%
4.3.13	Attenuation		
	Step Accuracy	± .5 dB	_____dB
	Vernier Range	20 ± .5 dB	_____dB
4.3.14	Markers		
	SCOPE VERT SIZE	0 to 8 Vpp	_____Vpp
	Option B PULSE MARKER	0 to +30 Vpp	_____Vpp
	OUTPUT Size	0 to -30 Vpp	_____Vpp
	PULSE MARKER	0 to +30 Vpp	_____Vpp
	OUTPUT Size	0 to -30 Vpp	_____Vpp
	Width	Approximately 1%	_____check
	Accuracy	± 0.02% (+25 - 0 kHz)	_____kHz
4.3.15	Programmer Lock	Maintain frequency lock at 10 MHz sweep width	_____check

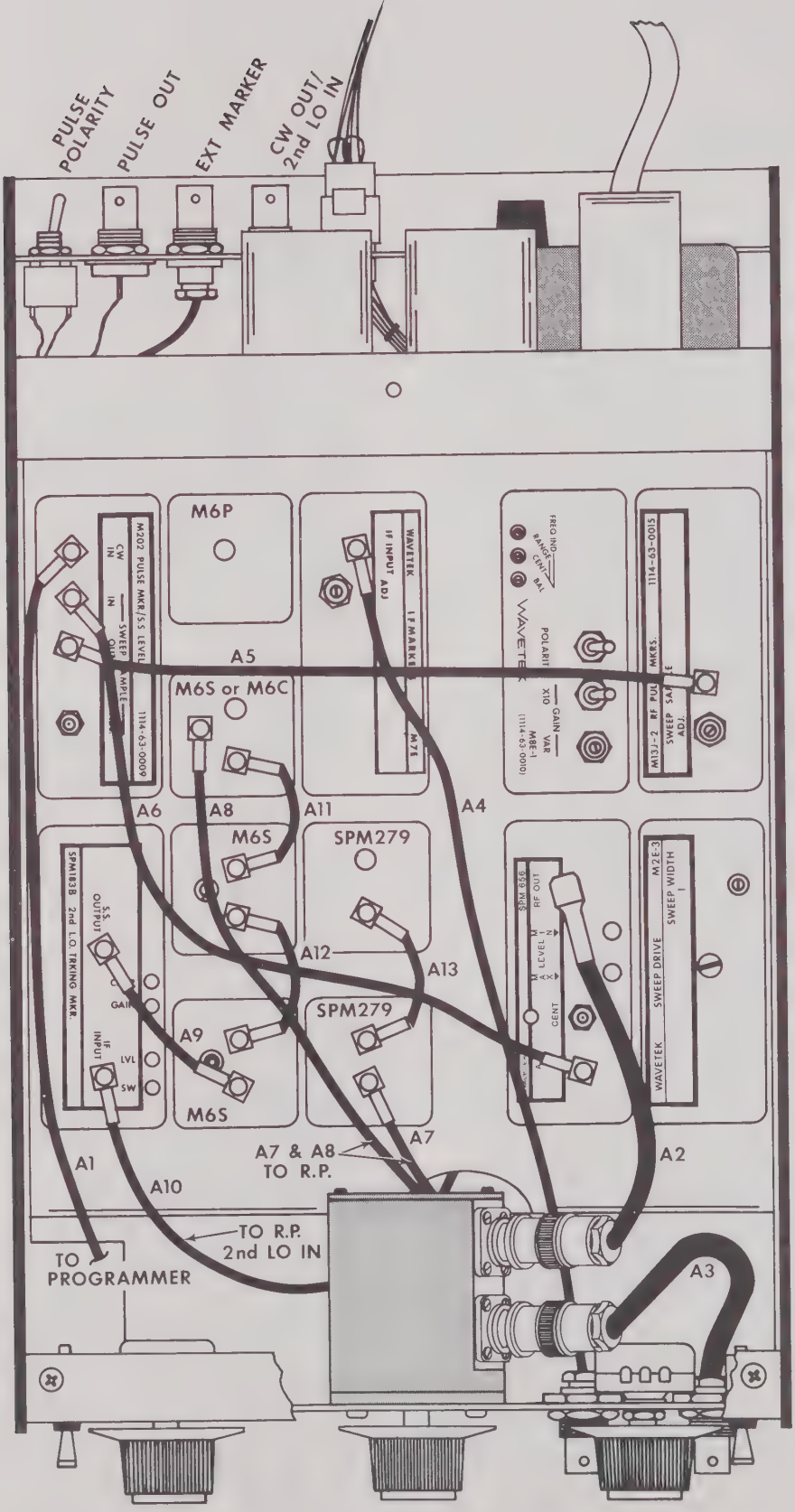
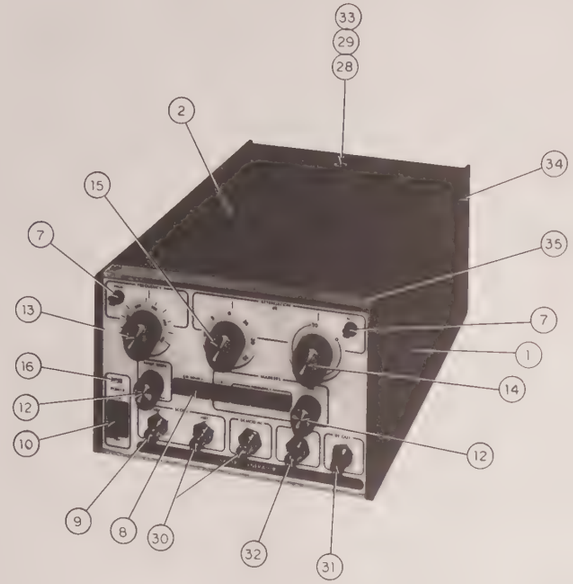


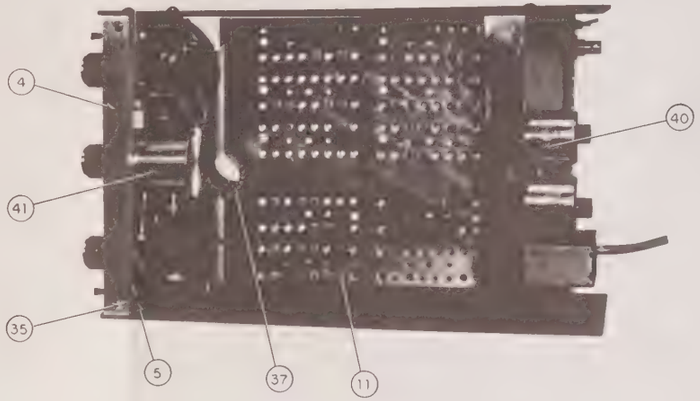
Figure 4-12. 1405 TOP VIEW

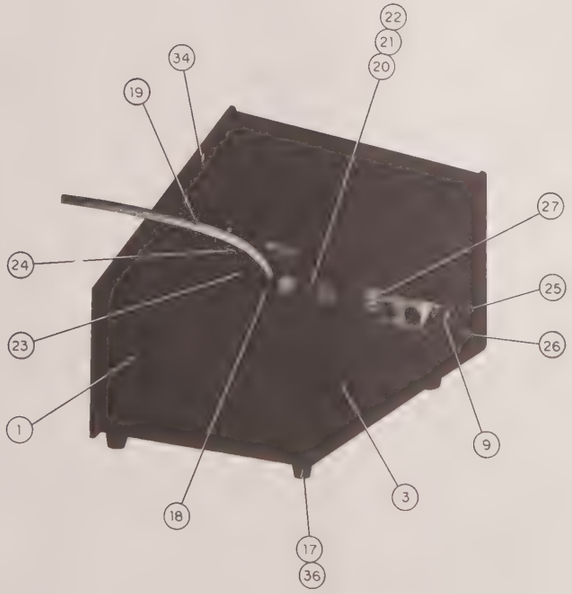
5.1 INTRODUCTION

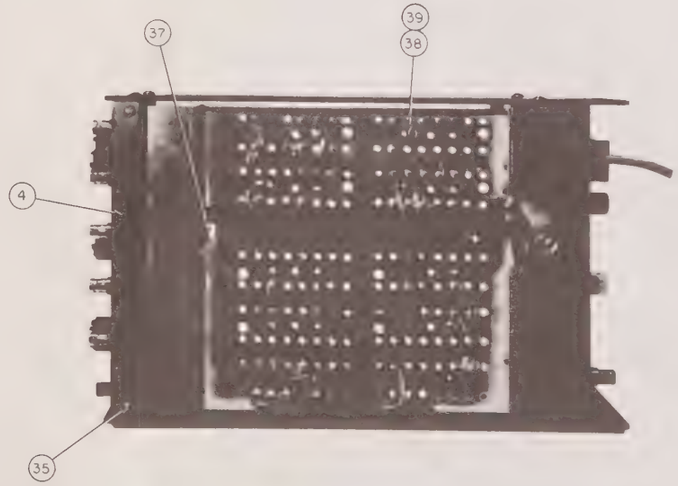
This section contains lists of all replaceable parts for the instrument.

PARTS LIST	ASSEMBLY
0619-40-0003	1405 Mechanical
0619-40-0004	Programmer Mechanical
1010-64-0007	1405 Sweep Generator
1010-64-0006	Programmer SP636
1110-63-0032	Mother Board
1110-63-0031	Frequency Control Card
1110-63-0030	Counter Card
1110-63-0050	Front Panel Board
1110-63-0033	Memory Board
1114-63-0008	SPM636 Phase Lock Module
1110-63-0040	SPM636 PC Assembly
1111-64-0009	SPM636 Chassis
1111-63-0009	1405 Front Panel Assembly
1112-62-0003	Power Switch Assembly
1115-00-0005	PS7 Power Supply
1218-00-0013	Power Supply Board
1219-00-0341	PS7 Harness
1219-62-0026	1405 Harness
1114-00-0419	SPM656 Sweep Oscillator
1110-00-1660	SPA656 PC-Sub-Assembly
1114-63-0043	M2E-3 Sweep Drive Module
1114-00-0122	M8 Vert/Marker Adder
1114-63-0009	M202 Pulse Marker Module
1114-00-0124	M6C External Marker
1114-00-0129	M6P Additional Pulse Markers
1118-63-0010	M6S Single Frequency Marker
1114-00-0197	M7E L.O. Tracking Markers
1114-63-0010	M8E-1 Auto Level
1110-63-0034	M8E-1 Main Board Assembly
1110-63-0035	M8E-1 Top Board Assembly
1114-00-0318	M13J-2 IF Markers
1114-00-0316	SPM183B 2nd L.O. Tracking Marker
1114-00-0369	SPM279 CW Source









REVISIONS				
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ITEM	DESCRIPTION	PART NUMBER	QTY
41	ATTEN. 7535-01	1113-20-0026	1
40	POWER SUPPLY PS7	1115-00-0005	1
39	SCREW, 6-32 X 1/8" PPH	2810-55-6102	9
38	GROUND LUG #6	2112-03-0003	10
37	CAT GROMMET	2810-10-0003	2
36	SCREW, 6-32 X 3/8" PPH	2810-55-6106	4
35	SCREW, 6-32 X 3/8" POH	2810-54-6106	4
34	SCREW, 8-32 X 1/4" PTH	2810-53-8104	8
33	SCREW, 8-32 X 1/2" PFH	2810-52-8108	1
32	CABLE ASSY, 12 1/2"	1217-80-0013	1
31	CABLE ASSY, 7 3/4"	1217-70-0004	1
30	CABLE ASSY, 20"	1217-80-0048	2
29	GROMMET, 3/8"	2810-10-0002	1
28	HUB	1416-10-0016	1
27	JUMPER PLUG	1118-00-0001	1
26	POT, 20K	4610-10-7203	1
25	SWITCH, SPDT	5106-00-0002	1
24	RIVET	2810-30-0007	2
23	SLIDE SWITCH	5105-00-0011	1
22	FUSE, .5 AMP	2410-05-0004	1
21	FUSEHOLDER BODY	2410-05-0010	1
20	FUSE CARRIER	2410-05-0009	1
19	CORD SET	6011-80-0001	1
18	STRAIN RELIEF	2810-10-0001	1
17	FEET	2810-08-0003	4
16	RECT. LED, RED	4810-02-0004	1
15	KNOB Z243	2410-01-1034	1
14	KNOB Z244	2410-01-1035	1
13	KNOB SP522	2410-01-1044	1
12	KNOB	2410-01-0005	2
11	PIN SOCKET	2112-00-0002	57
10	POWER SWITCH ASSY	1112-62-0003	1
9	BNC CONN.	2110-01-1013	2
8	BUTTON SWITCH CAP	5110-04-0001	6
7	TOGGLE SWITCH	5106-00-0009	2
6	FRONT PANEL	1416-30-0009	1
5	FRONT SUPPORT BRKT	1410-00-0560	2
4	SUPPORT RAIL	1410-00-1550	2
3	BOTTOM COVER	1410-00-4450	1
2	TOP COVER	1416-30-0015	1
1	SIDE PANELS	1410-00-4260	2

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
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FINISH:
NEXT ASSY: USED ON
APPLICATION
DO NOT SCALE DRAWING

CONTR. NO.
APPROVALS: DATE
DRAWN: D.J WATSON 1-17-84
CHECKED:
RELEASED:

WAVETEK INDIANA INC

1405 MECHANICAL LIST

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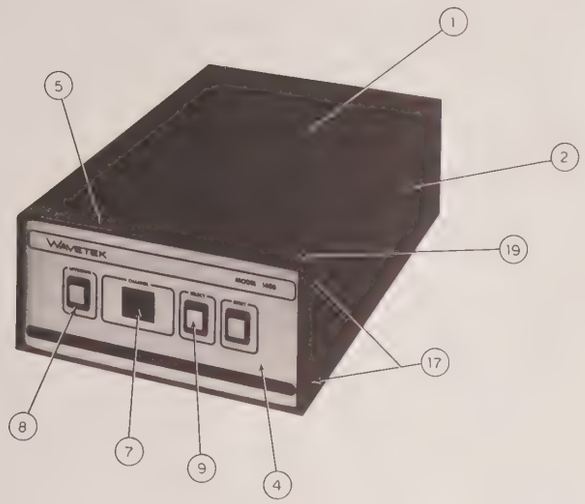
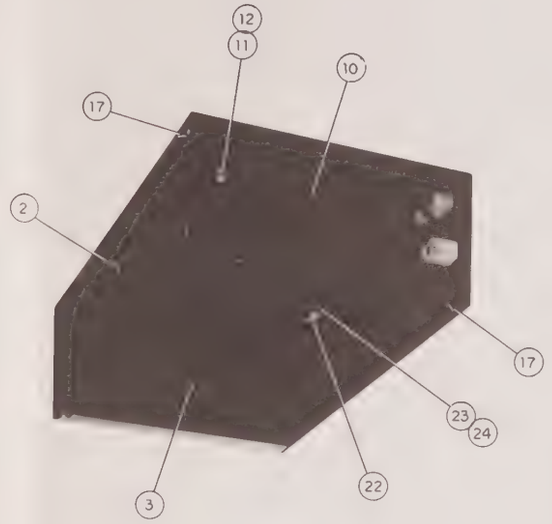
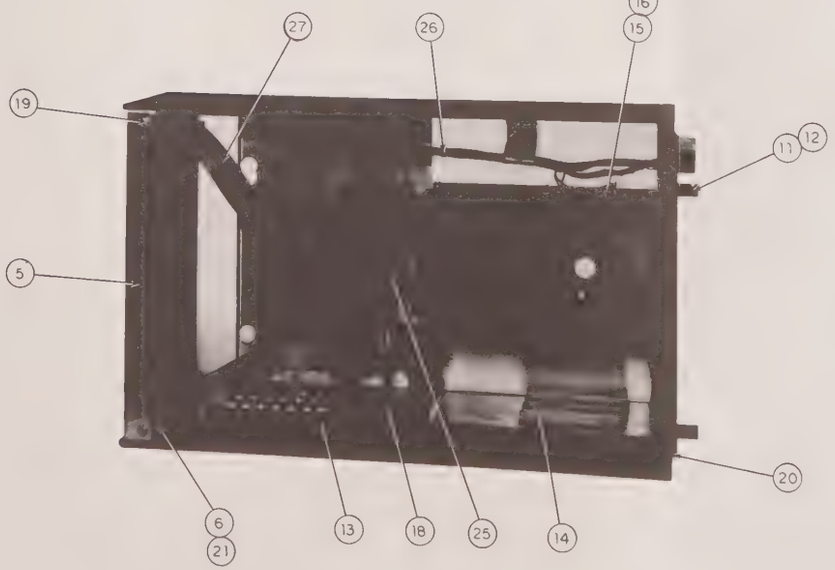
SCALE | SHEET 1 OF 1







REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

ITEM	DESCRIPTION	PART NUMBER	QTY
27	CABLE ASSY	1219-62-0021	2
26	HARNESS ASSY	1219-62-0020	1
25	HARNESS ASSY	1219-62-0019	1
24	SCREW, 4-40 X 1/4", PPH	2810-55-4104	2
23	LOCKWASHER INT, #4	2810-24-4000	2
22	FOOT ATTACHMENT	1416-10-0017	1
21	SCREW, 4-40 X 1/4", PFH	2810-52-4104	4
20	SCREW, 6-32 X 1/4", PFH	2810-52-6104	4
19	SCREW, 6-32 X 3/8", POH	2810-54-6106	4
18	RUBBER GROMMET, 1/2"	2810-10-0013	1
17	SCREW, 6-32 X 1/4", PTH	2810-53-6104	12
16	SCREW, 4-40 X 3/16" PPH	2810-55-4103	3
15	GROUND LUG #6	2112-03-0003	2
14	CARD GUIDE	2112-16-0003	8
13	SOCKET	2112-00-0002	19
12	SCREW, CPTV, #4-40	2810-09-0004	2
11	NUT, CPTV, #4-40	2810-09-0003	2
10	REAR PANEL	1416-20-0005	1
9	SWITCH CAP	5102-04-0003	3
8	SWITCH BEZEL	5102-03-0001	3
7	DISPLAY LENSE	1416-10-0006	1
6	FRONT SUPPORT	1416-10-0004	2
5	SUPPORT RAIL	1410-00-1550	2
4	FRONT PANEL	1416-21-1002	1
3	BOTTOM COVER	1416-30-0003	1
2	SIDE PANEL	1416-20-0006	2
1	TOP COVER	1416-20-0007	1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX ±.01 ±30 .XXX ±.005

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FINISH:

NEXT ASSY | USED ON

APPLICATION

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CONTRACT NO

APPROVALS	DATE
DRAWN DJ WATSON	1-19-89
CHECKED	
RELEASED	

WAVETEK INDIANA, INC

1405 PROGRAMMER
MECHANICAL LIST

SIZE D | CODE IDENT NO 34280 | DRAWING NO 0619-40-0004

SCALE | SHEET 1 OF 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
A05 A06	CABLE ASSY,8-1/2 IN	WX3000-200-W9	W-I	1217-00-0084	2.000
W01	CABLE ASSY, 14 IN	WX1405-W1	W-I	1217-00-0140	1.000
ZA01	PROGRAMMER,SP636(U)	1010-64-0006	W-I	1010-64-0006	1.000
ZA02	FP ASSY, 1405(U)	1405-FP	W-I	1111-63-0009	1.000
ZA03	POWER SUPPLY,PS7	PS7	W-I	1115-00-0005	1.000
ZA04	CHASSIS ASSY,1405(U)	1405-CHAS	W-I	1111-64-0012	1.000
ZA05	SWP OSC,SPM656	SPM656	W-I	1114-00-0419	1.000
ZA06	M2E-3 MODULE ASSY	1114-63-0043	W-I	1114-63-0043	1.000
ZA07	VERT/MKR ADDER,M8	M8	W-I	1114-00-0122	1.000
ZA08	PLS MKR,SS,LVLR,M202 (U)	M202	W-I	1114-63-0009	1.000

WAVETEK PARTS LIST	SWP GEN,1405 (U)	1010-64-0007 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
HH01	CABLE ASSY, 3 1/2 IN	WX1865-W4	W-I	1217-70-0061	1.000
HH02	CABLE ASSY,16 IN	WXRLS-W22	W-I	1217-00-0160	1.000
ZA01	MOTHER BOARDPER B/P (U)	SP636-MOTHER BD	W-I	1110-63-0032	1.000
ZA02	FREQ CTL CARDPER B/P (U)	1110-63-0031	W-I	1110-63-0031	1.000
ZA04	MEMORY BOARDPER B/P (U)	1110-63-0033	W-I	1110-63-0033	1.000
ZA05	PCB BRKT ASSYPER B/P	SP636-PCB BRKT	W-I	1111-62-0001	1.000
ZA06	FP ASSY,SP636-1405(U)	SP636-1405-FP	W-I	1111-63-0006	1.000
ZA07	CHASSIS,1405/SP636	SP636-CHAS	W-I	1111-64-0009	1.000
ZA08	SWP OSC,SPM656	SPM656	W-I	1114-00-0419	1.000
ZA09	PHASE LOCK MODSPM636	SPM636	W-I	1114-63-0008	1.000
ZA10	BOTTOM CVR AY,SP636 (U)	SP636-BTM CVR	W-I	1111-62-0002	1.000

WAVETEK PARTS LIST	PROGRAMMER,SP636 (U)	1010-64-0006 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
J01 J02 J03	HDR,DBL,STRT,50-PIN	102567-6	AMP	2112-07-0057	3.000
J04 J05	IC SKT,PC,14 PIN MC000-073	C931402	T-I	2112-00-0011	2.000
J08 J09	CONN.,RECEPT.,3-PIN	6-86105-3	AMP	2112-25-0001	2.000
P06	HEADER,9-PIN STRT REF:2112-07-0000	65501-409	BER	2112-07-0002	1.000
P07	HEADER,14-PIN STRT REF:2112-07-0000	65501-414	BER	2112-07-0031	1.000
P10	CONN.,RECEPT.,P.C., STRAIGHT	50-051-0000	SEL	2110-03-0004	1.000

WAVETEK PARTS LIST	MOTHER BOARD PER B/P (U)	1110-63-0032 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,8 PIN	DILB-8P-108	BURND	2112-00-0007	6.000
2	IC SKT,16 PIN MC000-074	DILB-16P-108	BURND	2112-00-0012	1.000
3	IC SKT,PC,24 PIN MC000-126	C932402	T-I	2112-00-0013	1.000
C01 C05 C06 C08 C10 C11 C12 C13 C14 C15 C18 C19 C20 C21 C22 C23	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	16.000
C02	CAP,TANT,25V,1UF	100DE105K25A2	ACI	1510-21-7010	1.000
C03 C04	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	2.000
C07	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	1.000
C09 C24 C25	CAP,DISC,100V,.15UF	CY20A154M	C-L	1510-11-1154	3.000
C16 C17	CAP,CER,5%,3300PF	C331C332J1G5CA	UNCAR	1510-12-7332	2.000
CR01 CR02	DIODE,SIGNAL	1N914	G-E	4807-01-0914	2.000
IC01	EPROM,2048X8 STATIC SENSITIVE	NMC27C16Q-45	NAT	8000-27-1610	1.000
IC02	VOLTAGE REF	REF-01CJ	PMI	7000-00-0100	1.000
IC03	DAC,8-BIT	DAC-08EQ	AMD	8000-00-0800	1.000
IC04 IC06 IC07 IC08 IC09	DUAL OP AMP	TL082CP	T-I	7000-00-8200	5.000
IC05	OP AMP LO NOISE	NE5534AN	SIG	7000-55-3401	1.000
J01	PV JUMPER	65474-002	BER	2112-10-0002	1.000
J103	SOCKET,DBL,50-PIN	102584-3	AMP	2112-00-0052	1.000
P01	HDR,RA,3-PIN REF:2112-08-0000	65524-403	BER	2112-08-0018	1.000
Q01	TRANS QA054-610	2N5461	MOT	4901-05-4610	1.000
Q02 Q03 Q04 Q05 Q06 Q07	TRANS QA054-580	2N5458	MOT	4901-05-4580	6.000
R01 R05 R06 R11 R12 R14 R18 R20 R24 R30 R31 R35 R38 R46 R54	RES,C,1/4W,5%,100	CF1/4-100	ASE	4700-15-1000	15.000
R02 R16 R21 R23 R41 R47	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	6.000
R03 R04	RES,MF,1/8W,1%,4.99K	RN55D-4.99K	MILSP	4701-03-4991	2.000
R07	RES,MF,1/8W,1%,10K	RN55D-10K	MILSP	4701-03-1002	1.000
R08	RES,C,1/4W,5%,7.5K	CF1/4-7.5K	ASE	4700-15-7501	1.000
R09	POT,2K,RP130-220	89PR2K	BEK	4610-00-2202	1.000
R10 R32 R33 R34	RES,MF,1/8W,1%,178K	RN55D-178K	MILSP	4701-03-1783	4.000
R13	RES,C,1/4W,5%,1.8M	CF1/4-1.8M	ASE	4700-15-1804	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R15 R40	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	2.000
R17	POT,1M,RP130-510	89PR1M	BEK	4610-00-2105	1.000
R19 R26 R27 R28 R48 R51	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	6.000
R22	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R25 R29	RES,C,1/4W,10%,100M	CB1071	A-B	4700-16-1006	2.000
R36	RES,C,1/4W,5%,1.5M	CF1/4-1.5M	ASE	4700-15-1504	1.000
R37	RES,C,1/4W,5%,15K	CF1/4-15K	ASE	4700-15-1502	1.000
R39	RES,C,1/4W,5%,3K	CF1/4-3K	ASE	4700-15-3001	1.000
R42 R45	RES,C,1/4W,5%,12K	CF1/4-12K	ASE	4700-15-1202	2.000
R43 R49	RES,C,1/4W,5%,5.6K	CF1/4-5.6K	ASE	4700-15-5601	2.000
R44 R50	RES,C,1/4W,5%,620	CF1/4-620	ASE	4700-15-6200	2.000
R52	RES,C,1/4W,5%,22	CF1/4-22	ASE	4700-15-2209	1.000
R53	RES,C,1/4W,5%,20K	CF1/4-20K	ASE	4700-15-2002	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,PC,14 PIN MC000-073	C931402	T-I	2112-00-0011	6.000
2	IC SKT,16 PIN MC000-074	DILB-16P-108	BURND	2112-00-0012	9.000
C01 C02 C03 C04 C05 C06 C08 C09 C10 C11 C12 C13 C14 C15	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	14.000
C07	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	1.000
C16	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	1.000
C17	CAP,DISC,1KV,.002UF	5GAD20	SPR	1510-10-1202	1.000
IC01 IC02 IC15	QUAD NAND STATIC SENSITIVE	MC14011BCP	MOT	8001-40-1112	3.000
IC03	DUAL NOR STATIC SENSITIVE	CD4002BC	NAT	8000-40-0210	1.000
IC04 IC05 IC06 IC07	COUNTER,BIN/DCD STATIC SENSITIVE	CD4029BC	NAT	8000-40-2910	4.000
IC08	DUAL D, FLIP-FLOP STATIC SENSITIVE	MC14013BCP	MOT	8001-40-1310	1.000
IC09 IC10 IC11	QUAD L-H VOLT SHFTR	CD40109BE	RCA	8004-01-0910	3.000
IC12 IC13	BCD/7-SEG DCDR STATIC SENSITIVE	CD4511DE	RCA	8000-45-1112	2.000
IC14	PROGRAMMABLE TIMER STATIC SENSITIVE	CD4541BC	NAT	8000-45-4110	1.000
J101	SOCKET,DBL,50-PIN	102584-3	AMP	2112-00-0052	1.000
R01 R02 R03 R04 R05 R06	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	6.000
R07	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R08 R09	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
DS01	DISPLAY,2-DIGIT, VACUUM FLUORESCENT	FG213B9	ITRON	2410-03-0004	1.000
J104 J105	IC SKT,PC,14 PIN MC000-073	C931402	T-I	2112-00-0011	2.000
R01	RES,C,2W,5%,220	HB2215	A-B	4700-45-2200	1.000
S01 S02 S03	SWITCH,PB,SPDT	8125-V3	C-K	5111-00-0012	3.000

WAVETEK PARTS LIST	FT PANEL BD ASSY	1110-63-0050 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,PC,14 PIN MC000-073	C931402	T-I	2112-00-0011	1.000
2	IC SKT,PC,24 PIN MC000-126	C932402	T-I	2112-00-0013	1.000
C01	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	1.000
C02	CAP,TANT,25V,1UF	100DE105K25A2	ACI	1510-21-7010	1.000
IC01	EPROM,2048X8 STATIC SENSITIVE	NMC27C16Q-45	NAT	8000-27-1610	1.000
IC02	DUAL 4-INT NAND GATE STATIC SENSITIVE	MC14012UBCD	MOT	8001-40-1213	1.000
J102	SOCKET,DBL,50-PIN	102584-3	AMP	2112-00-0052	1.000
R01	RES NTWK,SIP,5-220K	605-224J	EPITK	4770-00-0013	1.000
R02	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	1.000
S01	SWITCH,ROT,BCD	1A215002GF	EECO	5104-00-0039	1.000

WAVETEK PARTS LIST	MEMORY BOARD PER B/P (U)	1110-63-0033 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP,DISC,80/20,.01MF	M50.0180/20	RMC	1510-12-2103	1.000
C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C33	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	12.000
C32 C35	CAP,FT,500V,6.8PF	54-794-010-6B92	SPEC	1510-30-1689	2.000
J01	CONN JF000-004	27-21	APL	2110-03-0001	1.000
J101	PV JUMPER	65474-002	BER	2112-10-0002	1.000
L01 L02 L03 L04	TOROID,10T,1-1/4L	LA009-010-1	W-I	1810-05-0004	4.000
R03 R04 R05 R06	RES,C,1/8W,5%,1K RC101-210	CF1/8-1K	ASE	4700-05-1001	4.000
R29	RES,C,1/8W,5%,10	CF1/8-10	ASE	4700-05-1009	1.000
X01	CRYSTAL,2.00000 MHZ	X25W-2.00000	W-I	2310-00-1101	1.000
ZA01	PC ASSY,SPM636(U)	SPM636-PC	W-I	1110-63-0040	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,16 PIN MC000-074	DILB-16P-108	BURND	2112-00-0012	3.000
2	IC SKT,PC,24 PIN MC000-126	C932402	T-I	2112-00-0013	2.000
3	IC, SKT,28-PIN	C842802	T-I	2112-00-0023	1.000
C02	CAP,DISC,80/20,.1MF	M-12-.1-80/20	RMC	1510-12-2104	1.000
C03 C06 C10 C13 C19 C20	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	6.000
C04 C07 C11 C14	CAP,DISC,1000PF	B-GP.001 GMV .150	RMC	1510-12-1102	4.000
C05	CAP,DISC,80/20,.01MF	M50.0180/20	RMC	1510-12-2103	1.000
C08 C09	CAP,MICA,500V,270PF	DM15-271J	ARC	1510-50-0271	2.000
C12	CAP,TANT,25V,1UF	100DE105K25A2	ACI	1510-21-7010	1.000
C15 C16	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	2.000
C17 C18	CAP,FILM,.15 UF	225P15491XD3	SPR	1510-62-1154	2.000
C34	CAP,DISC,1KV,33PF	10TCC-Q33	SPR	1510-10-0330	1.000
IC01	PRESCALER,2-MOD	MC12011P	MOT	8001-20-1100	1.000
IC02	DUAL D FLIP-FLOP,ECL	MC10131P	MOT	8001-01-3100	1.000
IC03	PLL FREQ SYNTH STATIC SENSITIVE	MC145151L	MOT	8014-51-5110	1.000
IC04 IC05	EPROM,2048X8 STATIC SENSITIVE	NMC27C16Q-45	NAT	8000-27-1610	2.000
IC06 IC07	DUAL OP AMP	TL082CP	T-I	7000-00-8200	2.000
P101	HEADER,3-PIN STRT REF:2112-07-0000	65501-403	BER	2112-07-0001	1.000
R01 R02 R07	RES,C,1/8W,5%,1K RC101-210	CF1/8-1K	ASE	4700-05-1001	3.000
R08	RES,C,1/8W,5%,330K	CF1/8-330K	ASE	4700-05-3303	1.000
R09 R10 R14 R15	RES,C,1/8W,5%,1.5K	CF 1/8-1.5K	ASE	4700-05-1501	4.000
R11 R13	RES,C,1/8W,5%,30K	CF1/8-30K	ASE	4700-05-3002	2.000
R12	POT,2K	91AR2K	BEK	4610-00-7202	1.000
R16 R17	RES,C,1/8W,5%,7.5K	CF1/8-7.5K	ASE	4700-05-7501	2.000
R18 R19	RES,C,1/8W,5%,100 RC101-110	CF1/8-100	ASE	4700-05-1000	2.000
R20 R24	RES,C,1/8W,5%,75K	CF1/8-75K	ASE	4700-05-7502	2.000
R21 R27 R28	RES,C,1/8W,5%,10K	CF1/8-10K	ASE	4700-05-1002	3.000
R22	RES,C,1/8W,5%,4.7K	CF1/8-4.7K	ASE	4700-05-4701	1.000
R23	POT,20K	91AR-20K	BEK	4610-00-7203	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R25	POT,10K	91AR10K	BEK	4610-00-7103	1.000
R26	RES,C,1/8W,5%,2K	CF1/8-2K	ASE	4700-05-2001	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC01	VOLT REG, +12 V	LM340T-12	NAT	7000-03-4001	1.000
IC02	VOLT REG,+5V	78M05U1C	FCD	7000-78-0500	1.000

WAVETEK PARTS LIST	CHASSIS,1405/SP636	1111-64-0009 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
A02	CABLE ASSY, 5-1/2 IN	WX1402A-A2	W-I	1217-70-0003	1.000
A03	CABLE ASSY, 7-3/4 IN	WX1402A-A3	W-I	1217-70-0004	1.000
A04	CABLE ASSY,12-1/2 IN	WX1402A-A4	W-I	1217-80-0013	1.000
AT01	ATTEN, 7535-01	7535-01	W-I	1113-20-0026	1.000
CR01	LED,RED,RECT	MV57124	MNO	4810-02-0004	1.000
J01	CONN,BNC-F,50,PANEL UG-911A/U	KC79-146	KIN	2110-01-1013	1.000
R01 R05	POT,10K,RP134-310	RK45	CTS	4610-30-2103	2.000
R03 R04	POT,10KRP118-310	JAIN056S103MA	A-B	4610-10-5103	2.000
R06	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	1.000
R07	RES,C,1/4W,5%,1.5K	CF1/4-1.5K	ASE	4700-15-1501	1.000
S01 S02	SWITCH,TOG,BLK ANOD. ST001-006	7101P3NYZQ	C-K	5106-00-0009	2.000
S03	SWITCH ASSY,P.B., 6-POS.	2KCB060000-304BL	C-L	5110-00-0016	1.000
ZA01	POWER SWITCH ASSY	1405-PWR SW	W-I	1112-62-0003	1.000

WAVETEK PARTS LIST	FP ASSY, 1405 (U)	1111-63-0009 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	TERM, FEMALEMC000-042	02-06-1103	MOL	2113-05-0004	3.000
P9999	PLUG MC000-035	03-06-2042	MOL	2113-04-0002	1.000
S9999	SW,TOGGLE,	9201J2ZQ	C-K	5106-00-0026	1.000

WAVETEK PARTS LIST	POWER SWITCH ASSY	1112-62-0003 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	TERMINAL,HT104-003	1559-2	KEY	2112-19-0001	6.000
2	FUSE CARRIER, 3AG	031.1666	PCC	2410-05-0009	1.000
3	FUSEHOLDER,BODY WITH MTNG.NUT	031.1653	PCC	2410-05-0010	1.000
A01	POWER SUPPLY BOARD	PS7 CARD	W-I	1218-00-0013	1.000
C17	CAP,DISC,100V,.1UF	TGP-10	SPR	1510-10-2104	1.000
F01	FUSE,S.B.,.5 AMP MF000-007	MDL 1/2	BUS	2410-05-0004	1.000
HH01	HARNESS, PS7	WYPS7	W-I	1219-00-0341	1.000
J05	CONN,BNC-F,50,PANEL UG-911A/U	KC79-146	KIN	2110-01-1013	1.000
P3	CORD SET,18/3SVT,6FT BK,MLD.CAP,UL-APPRV	6011-80-0001	ECMC	6011-80-0001	1.000
Q02 Q03	TRANS QA052-940	2N5294	RCA	4901-05-2940	2.000
R44	POT,20K	WA2G032S-203MA	A-B	4610-10-7203	1.000
S01	SWITCH,SLIDE,DPDT	4021.0512	MARQ	5105-00-0011	1.000
S02	SWITCH,SPDTST000-003	MST-105D	ALC	5106-00-0002	1.000
T01	XFMR,PWR,TT000-022	TT000-022	W-I	5610-00-0006	1.000

WAVETEK PARTS LIST	POWER SUPPLY,PS7	1115-00-0005 PAGE: 1	I REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,8 PIN	DILB-8P-108	BURND	2112-00-0007	2.000
2	PAD,IC,10 LEAD,TO-5 HQ103-000	HT7717-21-DAP	THR	2810-11-0002	1.000
C01 C07	CAP,ELEC,50V,1250UF	20-36186	MAL	1510-20-7122	2.000
C02	CAP,ELEC,50V,50UF	TE1307	SPR	1510-20-5500	1.000
C03 C06 C11	CAP,ELEC,25V,100UF	TE1211	SPR	1510-20-4101	3.000
C04 C09	CAP,DISC,1KV,100PF	60U101M	MDC	1510-10-1101	2.000
C05	CAP,DISC,100V,.005UF	TG-D50	SPR	1510-10-2502	1.000
C08	CAP,DISC,1KV,120PF	60U121M	MDC	1510-10-1121	1.000
C10 C12 C14	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	3.000
C13	CAP,MYLR,100V,.15UF	WMF1P15	C-D	1510-60-2154	1.000
C16	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	1.000
CR01 CR02 CR03 CR04 CR05 CR06 CR07 CR08 CR09 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	17.000
IC01	VOLT REG	LM723CH	NAT	7000-17-2300	1.000
IC02	OP AMP	N5741CV	SIG	7000-57-4100	1.000
IC03	DUAL OP AMP	RC4558NB	RAY	7000-14-5800	1.000
P02	WAFERCON,MC000-031	1840-12-2	MOL	2112-09-0001	1.000
Q01 Q04 Q05	TRANS QA036-440	2N3644	FCD	4901-03-6440	3.000
Q06 Q13	TRANS QA039-040	2N3904	NAT	4901-03-9040	2.000
Q07	TRANS QA053-060	2N5306	G-E	4901-05-3060	1.000
Q12	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1.000
R01	RES,C,1/4W,5%,270	CF1/4-270	ASE	4700-15-2700	1.000
R02	RES,C,1/4W,5%,1.8K	CF1/4-1.8K	ASE	4700-15-1801	1.000
R03 R11 R21 R46	RES,MF,1/2W,1%,5	RN60D-5	MILSP	4701-23-0050	4.000
R04 R14	RES,MF,1/8W,1%,1K	RN55D-1K	MILSP	4701-03-1001	2.000
R05	RES,MF,1/8W,1%,12.1K	RN55D-12.1K	MILSP	4701-03-1212	1.000
R06	RES,C,1/4W,5%,1.5K	CF1/4-1.5K	ASE	4700-15-1501	1.000
R07	RES,C,1/4W,5%,220	CF1/4-220	ASE	4700-15-2200	1.000
R08	RES,C,1/4W,5%,3.9K	CF1/43.9K	ASE	4700-15-3901	1.000
R09	POT,1K,RP131-210	360T102B	CTS	4610-00-3102	1.000
R10	RES,C,1/4W,5%,2.7K	CF1/4-2.7K	ASE	4700-15-2701	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R12	RES,C,1/4W,5%,470	CF1/4-470	ASE	4700-15-4700	1.000
R13	RES,C,1/2W,5%,2.7K	CF1/2-2.7K	ASE	4700-25-2701	1.000
R15	RES,MF,1/8W,1%,15K	RN55D-15K	MILSP	4701-03-1502	1.000
R16 R17	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	2.000
R18	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	1.000
R19 R20	RES,SET,2-10K,1/8W QTY:2:4701-03-1002	RX000-003	W-I	4789-00-0004	1.000
R22 R29 R30 R38 R42	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	5.000
R23 R28 R39 R41	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	4.000
R24	RES,C,1/4W,5%,100	CF1/4-100	ASE	4700-15-1000	1.000
R25	RES,C,1/4W,5%,15K	CF1/4-15K	ASE	4700-15-1502	1.000
R26 R44	POT,20K,RP131-320	360T203B	CTS	4610-00-3203	2.000
R27	RES,C,1/4W,5%,220K	CF1/4220K	ASE	4700-15-2203	1.000
R31	RES,C,1/4W,5%,47	CF1/4-47	ASE	4700-15-4709	1.000
R40	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	1.000
R43	RES,C,1/4W,5%,18K	CF1/4-18K	ASE	4700-15-1802	1.000
R45	RES,C,1/2W,5%,220	CF1/2-220	ASE	4700-25-2200	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	TERMINAL,FEMALE MC000-018	02-06-1131	MOL	2113-05-0001	4.000
J01	RECEPTACLEMC000-034	03-06-1041	MOL	2113-03-0002	1.000

WAVETEK PARTS LIST	HARNESS, PS7	1219-00-0341 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
U01	RECEPTACLE,MC000-016	03-06-1151	MOL	2113-03-0001	1.000
U02	RECEPTACLE,MC000-030	03-09-1121	MOL	2113-08-0001	1.000
U03 U04	CONN,BNC-F,50,PANEL	KC19-175	KIN	2110-01-1012	2.000

WAVETEK PARTS LIST	HARNESS,1405 PER B/P	1219-62-0026 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP,COMP,500V,.47PF	QC-.47PF	Q-C	1510-40-0478	1.000
C02 C05	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	2.000
C03	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	1.000
C04	CAP,DISC,1KV,100PF	CN1500-100PF	RMC	1510-10-5101	1.000
C06 C07 C09	CAP,FT,250V,100PF	4420-100PF	AER	1510-30-3101	3.000
C08	CAP,DISC,50V,.01UF	CY15C103M	C-L	1510-10-8103	1.000
C10	CAP,COMP,500V,2.4PF	QC-2.4PF	Q-C	1510-40-0249	1.000
C13 C14	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	2.000
C15 C16 C17	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	3.000
C20	CAP,COMP,500V,.51PF	MC-.51PF	Q-C	1510-40-1518	1.000
CR01	DIODE,QUAD,BAL MIXER	5082-2830	H-P	4899-02-0001	1.000
CR05 CR06	DIODE,PIN	5082-3080	H-P	4805-02-0002	2.000
CR07 CR08 CR09	DIODE DC000-005	BB121A	ITT	4889-00-0001	3.000
J01	CONN JF000-004	27-21	APL	2110-03-0001	1.000
J02 J03	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2.000
J101	SOCKET,SIP,5-PIN	1-583773-2	AMP	2112-00-0040	1.000
L04	TOROID,10T,1-1/4L	LA009-010-1	W-I	1810-05-0004	1.000
L06	RES,C,1/4W,5%,4.7M	CB4755	A-B	4700-15-4704	1.000
L07 L08	CHOKE,COATED,.22UH	08NR22	JEF	1810-03-0228	2.000
L09	CHOKE,COATED,510UH	01054-48K	JEF	1810-03-0511	1.000
L10	CHOKE,COATED,2.2UH	08N2R2	JEF	1810-03-0229	1.000
L011	CHOKE,20T,32GA FROM:4705-16-4701	1210-33-0010	W-I	1210-33-0010	1.000
Q01	TRANS QB000-013	A430	APX	4902-00-4300	1.000
Q02	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1.000
Q03	TRANS QA051-790	2N5179	RCA	4901-05-1790	1.000
R01 R12	RES,C,1/4W,5%,680	CF1/4-680	ASE	4700-15-6800	2.000
R02 R03 R13 R14	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	4.000
R04	RES,C,1/4W,5%,47	CF1/4-47	ASE	4700-15-4709	1.000
R05	RES,C,1/4W,5%,33	CF1/4-33	ASE	4700-15-3309	1.000
R06 R07	RES,C,1/4W,5%,120	CF1/4-120	ASE	4700-15-1200	2.000
R08	RES,C,1/4W,5%,5.6K	CF1/4-5.6K	ASE	4700-15-5601	1.000
R09	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R10	POT,CONT,10KRV102-310	3067P-10K	BOU	4610-20-0103	1.000
R11	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	1.000
R15	RES,C,1/4W,5%,10	CF1/4-10	ASE	4700-15-1009	1.000
R16	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	1.000
R17	RES,L-A,1/4W,1%,75	SPS-N-347-75	IRC	4741-75-0007	1.000
R18 R19	RES,C,1/4W,5%,22	CF1/4-22	ASE	4700-15-2209	2.000
R20	RES,C,1/4W,5%,2K	CF1/4-2K	ASE	4700-15-2001	1.000
ZA01	PC SUB-ASSY,SPA656	SPA656	W-I	1110-00-1660	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	IC SKT,8 PIN	DILB-8P-108	BURND	2112-00-0007	1.000
C101	CAP,CHIP,1000PF,50V CC101-210	5BN050S102KS	VAR	1510-00-1102	1.000
C102 C103 C107 C108 C109 C110 C111 C112 C113 C114 C115 C118 C120 C123 C124 C126 C127 C128 C129 C132 C133 C138	CAP.,CHIP,.1 MF	51C1209-B104Z	CFI	1510-00-3104	22.000
C104 C116 C122 C125	CAP,CHIP,75PF	C1005C750J2GAH	UNCAR	1510-02-0750	4.000
C105 C106 C121	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	3.000
C117 C134	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	2.000
C119	CAP,DISC,1KV,100PF	60U101M	MDC	1510-10-1101	1.000
C130	CAP,DISC,1KV,.002UF	5GAD20	SPR	1510-10-1202	1.000
C131	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	1.000
C135	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	1.000
C136	CAP,DISC,1KV,47PF	10TCC-Q47	SPR	1510-10-0470	1.000
C137	CAP,COMP,500V,3PF	QC-3.0PF	Q-C	1510-40-0309	1.000
CR101 CR102	DIODE,PIN	MA47980	M-A	4805-02-0001	2.000
CR103	DIODE,1N82 MITEK PRE-TESTED,40UA	1N82-PRE-TEST	MTK	4807-03-0003	1.000
IC101	DUAL OP AMP	TL082CP	T-I	7000-00-8200	1.000
IC102 IC103 IC104 IC107	AMPL.,WIDE BAND,600-MHZ,55MA	MWA220	MOT	7000-02-2000	4.000
IC105 IC106	AMPL.,WIDE BAND,600-MHZ,100MA	MWA230	MOT	7000-02-3000	2.000
L101 L102 L103 L104 L105 L106 L107 L110	TOROID,10T,1-1/4L	LA009-010-1	W-I	1810-05-0004	8.000
L108	CHOKE,COATED,22UH	08N220	JEF	1810-03-0220	1.000
L109	TOROID,4T,1-1/4L	LA009-004-1	W-I	1810-05-0003	1.000
P101	HDR,STRT,5-PIN REF:2112-07-0000	65501-405	BER	2112-07-0024	1.000
Q101	TRANS QA050-880	2N5088	MOT	4901-05-0880	1.000
R101	RES,C,1/8W,5%,82	CF1/8-82	ASE	4700-05-8209	1.000
R102	RES,C,1/8W,5%,180	CF1/8-180	ASE	4700-05-1800	1.000
R103	RES,C,1/8W,5%,120	CF1/8-120	ASE	4700-05-1200	1.000
R104 R114 R120	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	3.000
R105	RES,C,1/8W,5%,51	CF1/8-51	ASE	4700-05-5109	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R106 R107 R108	RES,C,1/8W,5%,680	CF1/8-680	ASE	4700-05-6800	3.000
R109 R111	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	2.000
R110	RES,C,1/8W,5%,220K	CF1/8-220K	ASE	4700-05-2203	1.000
R112	RES,C,1/8W,5%,10K	CF1/8-10K	ASE	4700-05-1002	1.000
R113 R122	RES,C,1/4W,5%,24K	CF1/4-24K	ASE	4700-15-2402	2.000
R115	RES,C,1/8W,5%,680K	CF1/8-680K	ASE	4700-05-6803	1.000
R116 R123	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	2.000
R117	RES,C,1/4W,5%,4.7	CF1/4-4.7	ASE	4700-15-4708	1.000
R118	RES,C,1/8W,5%,15	CF-1/8-15	ASE	4700-05-1509	1.000
R119	RES,C,1/2W,5%,100	CF1/2-100	ASE	4700-25-1000	1.000
R121	RES,C,1/8W,5%,56	CF1/8-56	ASE	4700-05-5609	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C03 C05 C06 C07 C12	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	6.000
C02 C04	CAP,COMP,500V,3.9PF	QC-3.9PF	Q-C	1510-40-0399	2.000
C08 C11	CAP,COMP,500V,2.4PF	QC-2.4PF	Q-C	1510-40-0249	2.000
C09 C10	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	2.000
CR01 CR02 CR03 CR04 CR05	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	5.000
IC01	DUAL OP AMP	RC4558NB	RAY	7000-14-5800	1.000
Q01	TRANS-QA042-500	PN4250	FCD	4901-04-2500	1.000
R01 R02	RES,SET,3-178K,1/8W QTY:3:4701-03-1783	RX000-002	W-I	4789-00-0001	1.000
R04	RES,MF,1/8W,1%,10K	RN55D-10K	MILSP	4701-03-1002	1.000
R05	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	1.000
R06 R09 R11 R32	POT,20K,RP130-320	89PR20K	BEK	4610-00-2203	4.000
R07	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R08	RES,C,1/4W,5%,150K	CF1/4-150K	ASE	4700-15-1503	1.000
R10	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	1.000
R12 R13 R14 R33	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	4.000
R15	RES,C,1/4W,5%,470	CF1/4-470	ASE	4700-15-4700	1.000
R16 R28	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	2.000
R17 R22 R23	RES,C,1/4W,5%,220K	CF1/4220K	ASE	4700-15-2203	3.000
R18 R21 R24 R27 R30	POT,100K,RP130-410	89PR100K	BEK	4610-00-2104	5.000
R19 R20 R25 R26	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	4.000
R29	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R31	RES,C,1/4W,5%,18K	CF1/4-18K	ASE	4700-15-1802	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP,DISC,1KV,120PF	60U121M	MDC	1510-10-1121	1.000
C02 C03 C04	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	3.000
R01	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000

WAVETEK PARTS LIST	VERT/MKR ADDER,M8	1114-00-0122 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C26 C27 C35	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	4.000
C02 C04	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	2.000
C03	CAP,DISC,1KV,6.8PF	60C0H6R8D	MDC	1510-10-0689	1.000
C05	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	1.000
C06 C14	CAP,MICA,500V,180PF	DM15-1B1J	ARC	1510-50-0181	2.000
C07	CAP,DISC,1KV,4.7PF	10TCC-V47	SPR	1510-10-0479	1.000
C08	CAP,DISC,1KV,10PF	10TCC-Q10	SPR	1510-10-0100	1.000
C09 C10 C28 C29 C36	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	5.000
C11 C12 C13	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	3.000
C15	CAP,DISC,1KV,200PF	CCD-201	ARC	1510-10-1201	1.000
C16 C17 C21	CAP,DISC,100V,.005UF	TG-D50	SPR	1510-10-2502	3.000
C18 C19	CAP,DISC,1KV,470PF	60U471M	MDC	1510-10-1471	2.000
C20	CAP,DISC,1KV,20PF	60C0G200J	MDC	1510-10-0200	1.000
C22	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	1.000
C23 C24 C33	CAP,DISC,1KV,.002UF	5GAD20	SPR	1510-10-1202	3.000
C25 C34	CAP,DISC,100V,.025UF	TG-S25	SPR	1510-10-2253	2.000
C30	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	1.000
C31 C32	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	2.000
CR01 CR02	DIODE,PIN	MA47047	M-A	4805-02-0003	2.000
CR03	DIODE,SI PT CONTACT	1N82AG	G-I	4807-01-0082	1.000
CR04	DIODE,GE PT CONTACT	1N34A	HIT	4807-01-0034	1.000
CR05	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	1.000
IC01 IC02	OP AMP	N5741CV	SIG	7000-57-4100	2.000
J01 J02 J03	CONN JF000-005	37JR116-1	S-C	2110-03-0002	3.000
L01 L02	TOROID,10T,1-1/4L	LA009-010-1	W-I	1810-05-0004	2.000
L03 L04	RF CHOKE,64T	1210-32-0025	W-I	1210-32-0025	2.000
MX01	MIXER,DBL.BALANCED	CM-1	VARIL	3010-54-0001	1.000
Q01	TRANS QB000-020 STATIC SENSITIVE	480841	RCA	4902-40-8410	1.000
Q02 Q03 Q04 Q06 Q07 Q08 Q09 Q10	TRANS QA038-541 2N3854A	2N3854A	G-E	4901-03-8541	8.000
Q05	TRANS QA053-060	2N5306	G-E	4901-05-3060	1.000
R01 R02	RES,C,1/4W,5%,51	CF1/451	ASE	4700-15-5109	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R03 R07	RES,C,1/4W,5%,100	CF1/4-100	ASE	4700-15-1000	2.000
R04 R15	RES,C,1/4W,5%,220	CF1/4-220	ASE	4700-15-2200	2.000
R05 R14 R18 R24 R33 R34 R40	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	7.000
R06 R13 R23 R27 R36 R39 R42	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	7.000
R08 R16 R17 R22 R28	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	5.000
R09	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R10 R25	RES,C,1/4W,5%,270K	CF1/4-270K	ASE	4700-15-2703	2.000
R11	POT,20K	WA2G032S-203MA	A-B	4610-10-7203	1.000
R12 R20 R29	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	3.000
R19 R38	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	2.000
R21	RES,C,1/4W,5%,12K	CF1/4-12K	ASE	4700-15-1202	1.000
R26	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	1.000
R30	RES,C,1/4W,5%,220K	CF1/4220K	ASE	4700-15-2203	1.000
R31	RES,C,1/4W,10%,10M RC104-610	CB1061	A-B	4700-16-1005	1.000
R32 R35 R37 R41 R43	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	5.000
R44 R45	RES,C,1/4W,5%,68	CF1/4-68	ASE	4700-15-6809	2.000
R46	RES,1/4W,5%,130	CF1/4-130	ASE	4700-15-1300	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C03	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	1.000
C04	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	1.000
CR01	DIODE,SI PT CONTACT	1N82AG	G-I	4807-01-0082	1.000
L01	TORDID,4T,1-1/4L	LA009-004-1	W-I	1810-05-0003	1.000
Q01	TRANS QA039-040	2N3904	NAT	4901-03-9040	1.000
R01	RES,C,1/4W,5%,47	CF1/4-47	ASE	4700-15-4709	1.000
R02	RES,C,1/4W,5%,51	CF1/451	ASE	4700-15-5109	1.000
R03 R05	RES,C,1/4W,5%,470	CF1/4-470	ASE	4700-15-4700	2.000
R04	RES,C,1/4W,5%,150	CF1/4-150	ASE	4700-15-1500	1.000
R06	RES,C,1/4W,5%,180K	CF1/4-180K	ASE	4700-15-1803	1.000
R07	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R08 R10	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CAN,MKR FROM:3210-08-0038	A000-518	W-I	1410-00-0810	1.000
2	MKR. CHASSIS	A000-594	W-I	1410-00-1060	1.000
3	BASE,MKR FROM:3210-08-0039	A000-519	W-I	1410-00-0820	1.000
4	DECAL,MKR.OVERLAY	DMB-143	W-I	2410-04-0003	1.000
5	DECAL,MODULE ID TAG	DMB-138	W-I	2410-04-0002	1.000
6	SCW,SBH,6-32X1/8	4030NP	F-S	2810-17-6102	2.000
7	CLOVERLEAF FTE-12 HT101-000	011-6808-000-59-9	SEL	2112-18-0001	30.000
9	SCW,STH,10-32X5/16	4221NP	F-S	2810-20-0205	1.000
11	NUT,10-32,HEX HN101-900	8010NP	F-S	2810-14-0200	1.000
12	EYELET,1/16X5/32, HE109-000	1268	F-S	2810-10-0009	1.000
13	SHIELD	A000-820	W-I	1410-00-8460	1.000
14	IC SKT,8 PIN	DILB-8P-108	BURND	2112-00-0007	1.000
16	COILFORM,LB001-000	555-82619	HY-PL	1813-00-0001	2.000
17	SLUG CORE,LC000-001	11 CODE 57-9740	SCC	1813-00-0004	2.000
C1 C21	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	2.000
C2	CAP,DISC,1KV,4.7PF	10TCC-V47	SPR	1510-10-0479	1.000
C3 C8	CAP,MICA,500V,180PF	DM15-181J	ARC	1510-50-0181	2.000
C4 C6 C7	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	3.000
C9	CAP,DISC,1KV,200PF	CCD-201	ARC	1510-10-1201	1.000
C10	CAP,DISC,100V,.025UF	TG-S25	SPR	1510-10-2253	1.000
C11 C16 C19	CAP,DISC,100V,.005UF	TG-D50	SPR	1510-10-2502	3.000
C12 C13 C15	CAP,DISC,1KV,470PF	60U471M	MDC	1510-10-1471	3.000
C14	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	1.000
C17 C5	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	2.000
C18	CAP,DISC,1KV,270PF	60U271M	MDC	1510-10-1271	1.000
C20	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	1.000
C22	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	1.000
CR1	DIODE,GE PT CONTACT	1N34A	HIT	4807-01-0034	1.000
CR2	DIODE,RECT,800V	ED30015	ETP	4806-01-4006	1.000
IC1	OP AMP	N5741CV	SIG	7000-57-4100	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L1 L2	RF CHOKE,REF ONLY	CHOKE	W-I	1819-99-9999	2.000
Q1	TRANS QB000-016 STATIC SENSITIVE	40673	RCA	4902-40-6730	1.000
Q2 Q3 Q4 Q5 Q6 Q7	TRANS QA038-541 2N3854A	2N3854A	G-E	4901-03-8541	6.000
R1	RES,C,1/4W,10%,10M RC104-610	CB1061	A-B	4700-16-1005	1.000
R2	RES,C,1/4W,5%,220K	CF1/4220K	ASE	4700-15-2203	1.000
R3	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	1.000
R5	RES,C,1/4W,5%,220	CF1/4-220	ASE	4700-15-2200	1.000
R10 R23 R4	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	3.000
R11 R15 R20 R21 R8	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	5.000
R12	RES,C,1/4W,5%,12K	CF1/4-12K	ASE	4700-15-1202	1.000
R13 R18 R6 R7	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	4.000
R14 R9	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	2.000
R16	RES,C,1/4W,5%,270K	CF1/4-270K	ASE	4700-15-2703	1.000
R17	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	1.000
R19 R22	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1	CAP,DISC,1KV,47PF	60U2J470J	MDC	1510-10-3470	1.000
C2	CAP,DISC,1KV,20PF	60C0G200J	MDC	1510-10-0200	1.000
C3	CAP,DISC,1KV,120PF	10TCU-T12	SPR	1510-10-3121	1.000
C4 C9	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	2.000
C5	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	1.000
C10	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	1.000
C11	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	1.000
C12	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	1.000
C13	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	1.000
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2.000
L1	COILFORM,LB001-000	555-B2619	HY-PL	1813-00-0001	1.000
L2	CHOKE,COATED,2.2UH	08N2R2	JEF	1810-03-0229	1.000
Q1 Q2	TRANS QA039-040	2N3904	NAT	4901-03-9040	2.000
R1	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R2	RES,C,1/4W,5%,56	CF1/4-56	ASE	4700-15-5609	1.000
R3	RES,C,1/4W,5%,1.5K	CF1/4-1.5K	ASE	4700-15-1501	1.000
R5	RES,C,1/4W,5%,180K	CF1/4-180K	ASE	4700-15-1803	1.000
R6	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R7 R9	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	2.000
R8	POT,20K	WA2G032S-203MA	A-B	4610-10-7203	1.000
X1	CRYSTAL,XX000-331	X33W-00.00000	W-I	2310-00-0331	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	CHASSIS,MOD M	A001-186	W-I	1410-00-3360	1.000
2	CAN,M,MOD	A000-304	W-I	1410-00-0550	1.000
4	BASE,MOD FROM:3210-08-0033	A000-250	W-I	1410-00-0510	1.000
5	INDEX STUD	A001-009	W-I	1410-00-2680	1.000
6	NUT,6-32X1/4HN101-600	8005NP	F-S	2810-14-6100	2.000
7	INT,LOWASHER,6 HW101-600	1304ZP	F-S	2810-24-6000	2.000
8	CLOVERLEAF FTE-12 HT101-000	011-6808-000-59-9	SEL	2112-18-0001	89.000
9	CLOVERLEAF FTE-15 HT102-000	011-6809-00-0-599	SEL	2112-18-0002	4.000
14	SHIELD	A000-865	W-I	1410-00-2320	1.000
15	SHIELD	A000-866	W-I	1410-00-2330	1.000
16	SHIELD	A000-911	W-I	1410-00-2520	1.000
23	IC SKT,8 PIN	DILB-8P-108	BURND	2112-00-0007	1.000
25	SCW,SBH,6-32X1/4	6-32X1/4,UC,BH,NP	S-S	2810-17-6104	1.000
C01 C02	CAP,DISC,1KV,33PF	10TCC-Q33	SPR	1510-10-0330	2.000
C03	CAP,DISC,1KV,100PF	60U101M	MDC	1510-10-1101	1.000
C04 C15	CAP,DISC,1KV,10PF	10TCC-Q10	SPR	1510-10-0100	2.000
C05 C21 C37A C37B C37C C38A C38B C38C C42 C55*	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	10.000
C06 C07 C16 C17 C22 C44	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	6.000
C08 C09 C23 C28 C50	CAP,DISC,100V,.025UF	TG-S25	SPR	1510-10-2253	5.000
C10 C20 C27 C29 C46	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	5.000
C11 C24 C25	CAP,DISC,1KV,47PF	60U2J470J	MDC	1510-10-3470	3.000
C12 C19	CAP,DISC,1KV,20PF	60C0G200J	MDC	1510-10-0200	2.000
C13 C40 C41	CAP,DISC,1KV,120PF	10TCU-T12	SPR	1510-10-3121	3.000
C14	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	1.000
C18	CAP,DISC,1KV,68PF	68U2J680J	MDC	1510-10-3680	1.000
C26	CAP,DISC,1KV,25PF	60C0G250J	MDC	1510-10-0250	1.000
C30 C32 C34	CAP,VAR,3.5-13PF	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	3.000
C36A C36B C36C C39A C39B C39C	CAP,DISC,1KV,200PF	CCD-201	ARC	1510-10-1201	6.000
C43 C47 C55	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	3.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C45	CAP,DISC,100V,.02UF	TG-S20	SPR	1510-10-2203	1.000
C48* C49	CAP,TANT,50V,.47UF	T310A474050AS	UNCAR	1510-21-9470	2.000
C51 C53	CAP,TANT,25V,10UF	100DE106M20C2	ACI	1510-21-7100	2.000
C52 C54	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	2.000
CR01 CR06	DIODE,RECT,400V	1N4004	P-C	4806-01-4004	2.000
CR02 CR03A CR03B CR03C CR04A CR04B CR04C CR05	DIODE,GE PT CONTACT	1N34A	HIT	4807-01-0034	8.000
IC01	OP AMP	N5741CV	SIG	7000-57-4100	1.000
J01	CONN JF000-005	37JR116-1	S-C	2110-03-0002	1.000
L01 L02 L03	CHOKE,COATED,.22UH	08NR22	JEF	1810-03-0228	3.000
L04	RF CHOKE,VAR,15T	1210-32-0023	W-I	1210-32-0023	1.000
L05	RF CHOKE,VAR,7T	1210-32-0024	W-I	1210-32-0024	1.000
L06	TOROID,4T,1-1/4L	LA009-004-1	W-I	1810-05-0003	1.000
L07 L09	RF CHOKE,VAR,35T	1210-32-0022	W-I	1210-32-0022	2.000
L08	CHOKE,COATED,2.2UH	08N2R2	JEF	1810-03-0229	1.000
Q01 Q03 Q04	TRANS QB000-020 STATIC SENSITIVE	480841	RCA	4902-40-8410	3.000
Q05 Q06	TRANS QA051-790	2N5179	RCA	4901-05-1790	2.000
Q10 Q13	TRANS QB000-009	MPS3702	NAT	4902-03-7020	2.000
Q11 Q12 Q2 Q7A Q7B Q7C Q8A Q8B Q8C Q9A Q9B Q9C	TRANS QA039-040	2N3904	NAT	4901-03-9040	12.000
R01 R02	RES,C,1/4W,5%,56	CF1/4-56	ASE	4700-15-5609	2.000
R03	POT,1KRP124-210	WA2G032S-102MA	A-B	4610-10-7102	1.000
R04 R11 R16	RES,C,1/4W,10%,22M	CB2261	A-B	4700-16-2205	3.000
R05 R13 R17	RES,C,1/4W,5%,220	CF1/4-220	ASE	4700-15-2200	3.000
R06 R23	RES,C,1/4W,5%,47	CF1/4-47	ASE	4700-15-4709	2.000
R07 R14 R19	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	3.000
R08 R31A R31B R31C R35A R35B R35C R43 R44	RES,C,1/4W,5%,27K	CF1/4-27K	ASE	4700-15-2702	9.000
R09	RES,C,1/4W,5%,68	CF1/4-68	ASE	4700-15-6809	1.000
R10	RES,C,1/4W,5%,56K	CF1/4-56K	ASE	4700-15-5602	1.000
R15 R20	RES,C,1/4W,5%,10	CF1/4-10	ASE	4700-15-1009	2.000
R18 R26 R27 R28A R28B R28C R32A R32B R32C R54	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	10.000
R21 R22 R40 R46	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	4.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R24	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	1.000
R25	RES,C,1/4W,5%,68K	CF1/4-68K	ASE	4700-15-6802	1.000
R29A R29B R29C R34A R34B R34C R39 R42	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	8.000
R30A R30B R30C	RES,C,1/4W,5%,1.8M	CF1/4-1.8M	ASE	4700-15-1804	3.000
R33A R33B R33C R41	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	4.000
R36 R37 R45	RES,C,1/4W,5%,18K	CF1/4-18K	ASE	4700-15-1802	3.000
R38	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R47	RES,C,1/4W,5%,1.5M	CF1/4-1.5M	ASE	4700-15-1504	1.000
R48	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R49 R50	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	2.000
R51	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	1.000
R52	RES,C,1/4W,5%,3.9K	CF1/43.9K	ASE	4700-15-3901	1.000
R53	RES,C,1/4W,5%,270K	CF1/4-270K	ASE	4700-15-2703	1.000
R55 R56	RES,C,1/4W,5%,22	CF1/4-22	ASE	4700-15-2209	2.000
T01	RF XFMR FROM:1813-00-0008	1210-41-0008	W-I	1210-41-0008	1.000
X01	CRYSTAL,XX000-331	X33W-00.00000	W-I	2310-00-0331	1.000
X02 X03 X04	CRYSTAL,XX000-391	X39W-00.00000	W-I	2310-00-0391	3.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C26	CAP,DISC,1KV,120PF	60U121M	MDC	1510-10-1121	1.000
C27 C28 C29	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	3.000
C30 C31 C32 C33 C34 C35 C36 C37	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	8.000
R04	POT,20K	WA2G032S-203MA	A-B	4610-10-7203	1.000
S01 S02	SWITCH,SPDTST000-003	MST-105D	ALC	5106-00-0002	2.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP,MON,100V,.1UF	CW30A104K	C-L	1510-15-1104	1.000
C02 C03 C05 C06 C11 C14 C17 C18	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	8.000
C04	CAP,FILM,250V,.047UF	818347254	REI	1510-60-9473	1.000
C12	CAP,DISC,1KV,10PF	10TCC-Q10	SPR	1510-10-0100	1.000
C13	CAP,DISC,1KV,470PF	60U471M	MDC	1510-10-1471	1.000
C15 C16	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	2.000
CR02 CR03	DIODE,SIGNAL	1N914	G-E	4807-01-0914	2.000
IC01 IC02	DUAL OP AMP	TL082CP	T-I	7000-00-8200	2.000
IC04 IC05	DUAL OP AMP,RAY ONLY	RC4558NB-RAY	RAY	7000-45-5801	2.000
J01	SOCKET, SIP, 9-PIN	583773-2	AMP	2112-00-0050	1.000
J02	SOCKET,SIP,5-PIN	1-583773-2	AMP	2112-00-0040	1.000
Q01	TRANS QA039-040	2N3904	NAT	4901-03-9040	1.000
R01	RES,C,1/4W,5%,2.2M	CF1/4-2.2M	ASE	4700-15-2204	1.000
R02	RES,C,1/4W,5%,91K	CF1/4-91K	ASE	4700-15-9102	1.000
R03 R12 R13 R29	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	4.000
R05	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	1.000
R06	RES,C,1/4W,5%,9.1K	CF1/4-9.1K	ASE	4700-15-9101	1.000
R07 R17	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	2.000
R08 R10 R39 R77	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	4.000
R09	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	1.000
R11 R28 R31	POT,20K,RP130-320	89PR20K	BEK	4610-00-2203	3.000
R16 R27 R30	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	3.000
R18	RES,C,1/4W,10%,22M	CB2261	A-B	4700-16-2205	1.000
R26	RES,C,1/4W,5%,180K	CF1/4-180K	ASE	4700-15-1803	1.000
R32	RES,C,1/4W,5%,39K	CF1/4-39K	ASE	4700-15-3902	1.000
R33	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	1.000
R34	RES,C,1/4W,5%,150K	CF1/4-150K	ASE	4700-15-1503	1.000
R35	RES,C,1/4W,5%,33K	CF1/4-33K	ASE	4700-15-3302	1.000
R36	RES,C,1/4W,5%,8.2K	CF1/4-8.2K	ASE	4700-15-8201	1.000
R37	RES,C,1/4W,5%,12K	CF1/4-12K	ASE	4700-15-1202	1.000
R38	RES,MF,1/8W,1%,16.9K	RN55D-16.9K	MILSP	4701-03-1692	1.000
R40	RES,C,1/4W,10%,2M	CB2055	A-B	4700-15-2004	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R41	RES,MF,1/8W,1%,40.2K	RN55D-40.2K	MILSP	4701-03-4022	1.000
R42	RES,C,1/4W,5%,20K	CF1/4-20K	ASE	4700-15-2002	1.000
R43	RES,MF,1/8W,1%,46.4K	RN55D-46.4K	MILSP	4701-03-4642	1.000
R44 R47	RES,MF,1/8W,1%,16.2K	RN55D-16.2K	MILSP	4701-03-1622	2.000
R45	RES,C,1/4W,5%,75K	CF1/4-75K	ASE	4700-15-7502	1.000
R46	RES,MF,1/8W,1%,42.2K	RN55D-42.2K	MILSP	4701-03-4222	1.000
R48	RES,MF,1/8W,1%,90.9K	RN55D-90.9K	MILSP	4701-03-9092	1.000
R49	RES,C,1/4W,10%,100M	CB1071	A-B	4700-16-1006	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C07	CAP,DISC,1KV,47PF	10TCC-Q47	SPR	1510-10-0470	1.000
C08 C10 C21 C22	CAP,MON,50V,1UF	3420-050-E105M	AER	1510-11-3105	4.000
C09	CAP,MICA,300V,3PF	DM5-030D	ARC	1510-50-1309	1.000
C19 C23	CAP,DISC,100V,.15UF	CY20A154M	C-L	1510-11-1154	2.000
C20 C24	CAP,FILM,250V,.047UF	818347254	REI	1510-60-9473	2.000
CR01 CR04 CR05 CR06	DIODE,SIGNAL	1N914	G-E	4807-01-0914	4.000
CR7	DIODE,ZENER,6.8V	1N4736A	MOT	4801-02-0001	1.000
IC03	DUAL OP AMP,RAY ONLY	RC4558NB-RAY	RAY	7000-45-5801	1.000
IC06	DUAL OP AMP	TL082CP	T-I	7000-00-8200	1.000
P01	HDR,STRT, 9-PIN, REF:2112-07-0023	65646-409	BER	2112-07-0051	1.000
P02	HDR,STRT, 5-PIN REF:2112-07-0023	65646-405	BER	2112-07-0050	1.000
Q02 Q03 Q04 Q05 Q07	TRANS QA054-580	2N5458	MOT	4901-05-4580	5.000
Q06	TRANS QA036-440	2N3644	FCD	4901-03-6440	1.000
Q08 Q09	TRANS QB000-009	MPS3702	NAT	4902-03-7020	2.000
R14 R15 R51	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	3.000
R19 R64	RES,C,1/4W,5%,10M	CB1065	A-B	4700-15-1005	2.000
R20	RES,C,1/4W,10%,22M	CB2261	A-B	4700-16-2205	1.000
R21 R50 R60	RES,C,1/4W,10%,100M	CB1071	A-B	4700-16-1006	3.000
R22	RES,C,1/4W,5%,120K	CF1/4-120K	ASE	4700-15-1203	1.000
R23 R58	RES,C,1/4W,5%,18K	CF1/4-18K	ASE	4700-15-1802	2.000
R24 R69	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	2.000
R25	RES,C,1/4W,5%,39K	CF1/4-39K	ASE	4700-15-3902	1.000
R52 R54 R55 R65	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	4.000
R53	RES,C,1/4W,5%,470K	CF1/4-470K	ASE	4700-15-4703	1.000
R56 R62	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	2.000
R57	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	1.000
R59 R63 R66	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	3.000
R61	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	1.000
R67	RES,C,1/4W,5%,2.7K	CF1/4-2.7K	ASE	4700-15-2701	1.000
R68	RES,C,1/4W,5%,24K	CF1/4-24K	ASE	4700-15-2402	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C08 C09 C10 C11 C12	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	6.000
C02	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	1.000
C03 C04 C05 C06 C07	CAP,VAR,3.5-13PF	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	5.000
C13 C29	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	2.000
C14 C15 C16 C17 C18	CAP,DISC,1KV,200PF	CCD-201	ARC	1510-10-1201	5.000
C19 C22	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	2.000
C20 C21 C24 C25 C26 C27 C28	CAP,FT,500V,1000PF	54-794-010-102P	SPEC	1510-30-8102	7.000
C23	CAP,DISC,1KV,120PF	60U121M	MDC	1510-10-1121	1.000
CR01 CR02 CR03 CR04 CR05	DIODE,SCHOTTKY	5082-2835	H-P	4809-02-0002	5.000
CR06 CR07 CR08 CR09 CR10 CR11 CR12 CR13	DIODE,SIGNAL	1N914	G-E	4807-01-0914	8.000
IC01 IC02 IC03	DUAL OP AMP	RC4558NB	RAY	7000-14-5800	3.000
J01	CONN JF000-005	37JR116-1	S-C	2110-03-0002	1.000
Q01 Q09	TRANS QA050-530	2N5053	APX	4901-05-0530	2.000
Q02 Q03 Q04 Q05 Q06	TRANS QB000-009	MPS3702	NAT	4902-03-7020	5.000
Q08	TRANS QA038-541 2N3854A	2N3854A	G-E	4901-03-8541	1.000
R01	POT,1KRP124-210	WA2G032S-102MA	A-B	4610-10-7102	1.000
R02	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R03	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	1.000
R04	RES,C,1/4W,5%,56	CF1/4-56	ASE	4700-15-5609	1.000
R05 R06 R07 R08 R09 R38 R39 R40 R41 R42	RES,C,1/4W,5%,5.6K	CF1/4-5.6K	ASE	4700-15-5601	10.000
R10 R11 R12 R13 R14	RES,C,1/4W,5%,270	CF1/4-270	ASE	4700-15-2700	5.000
R15 R34	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	2.000
R16	RES,C,1/4W,5%,1.5M	CF1/4-1.5M	ASE	4700-15-1504	1.000
R17 R18 R19 R20 R21	RES,C,1/4W,5%,360K	CF1/4-360K	ASE	4700-15-3603	5.000
R22 R23 R24 R25 R26	RES,C,1/4W,5%,51K	CF1/4-51K	ASE	4700-15-5102	5.000
R28 R29 R30 R31 R32 R36 R47 R48 R49 R50 R51	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	11.000
R35	RES,C,1/4W,5%,56K	CF1/4-56K	ASE	4700-15-5602	1.000
R37	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	1.000
R43	RES,C,1/4W,5%,3.3K	CF1/4-3.3K	ASE	4700-15-3301	1.000
R44	RES,C,1/4W,5%,2.7K	CF1/4-2.7K	ASE	4700-15-2701	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R45	RES,C,1/4W,5%,820	CF1/4-820	ASE	4700-15-8200	1.000
R46	RES,C,1/4W,5%,10	CF1/4-10	ASE	4700-15-1009	1.000
T01	RF XFMR FROM:1813-00-0007	1210-40-0017	W-I	1210-40-0017	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	>< ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C08	CAP,DISC,1KV,.002UF	5GAD20	SPR	1510-10-1202	1.000
C09 C10 C14 C15 C16 C17 C31	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	7.000
C11 C12 C30	CAP,DISC,100V,.01UF	68U103M	MDC	1510-10-2103	3.000
C13	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	1.000
C18	CAP,DISC,1KV,47PF	10TCC-Q47	SPR	1510-10-0470	1.000
C19 C20 C23 C24 C25 C29 C32	CAP,FT,500V,6.8PF	54-794-010-6892	SPEC	1510-30-1689	7.000
C21 C22	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	2.000
C26	CAP.,CHIP,.1 MF	51C1209-B104Z	CFI	1510-00-3104	1.000
C27	CAP,VAR,3.5-13PF	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	1.000
C28	CAP,DISC,1KV,.003UF	5GA-D30	SPR	1510-10-1302	1.000
C33 C34	CAP,DISC,100V,.05UF	TG-S50	SPR	1510-10-2503	2.000
CR01 CR02 CR03 CR04	DIODE DC000-005	BB121A	ITT	4889-00-0001	4.000
CR05 CR06	DIODE,PIN	MA47980	M-A	4805-02-0001	2.000
CR07 CR08 CR09 CR10	DIODE,SCHOTTKY	5082-2835	H-P	4809-02-0002	4.000
CR11	DIODE,SI PT CONTACT	1N82AG	G-I	4807-01-0082	1.000
CR12	DIODE,SIGNAL	1N914	G-E	4807-01-0914	1.000
IC1 IC2 IC3	DUAL OP AMP,RAY ONLY	RC4558NB-RAY	RAY	7000-45-5801	3.000
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2.000
L04	TOROID,4T,1-1/4L	LA009-004-1	W-I	1810-05-0003	1.000
L05 L06 L07 L09	TOROID,10T,1-1/4L	LA009-010-1	W-I	1810-05-0004	4.000
L08 L10	RF CHOKE,REF ONLY	CHOKE	W-I	1819-99-9999	2.000
Q1	TRANS QA051-090	2N5109	SSS	4901-05-1090	1.000
Q2	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1.000
Q3	TRANS QA050-880	2N5088	MOT	4901-05-0880	1.000
Q4	TRANS QA039-040	2N3904	NAT	4901-03-9040	1.000
Q5	TRANS QA054-610	2N5461	MOT	4901-05-4610	1.000
R04	RES,C,1/4W,5%,47	CF1/4-47	ASE	4700-15-4709	1.000
R05 R15 R18	RES,C,1/4W,5%,27K	CF1/4-27K	ASE	4700-15-2702	3.000
R06 R08 R19 R30 R37	RES,C,1/4W,5%,4.7K	CF1/4-4.7K	ASE	4700-15-4701	5.000
R07 R16	RES,C,1/4W,5%,100	CF1/4-100	ASE	4700-15-1000	2.000
R09 R10 R24 R25	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	4.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R11 R20 R21 R26 R28 R41	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	6.000
R12	RES,C,1/4W,5%,560	CF1/4-560	ASE	4700-15-5600	1.000
R13	RES,C,1/4W,5%,2.2K	CF1/4-2.2K	ASE	4700-15-2201	1.000
R14	RES,C,1/4W,5%,51	CF1/451	ASE	4700-15-5109	1.000
R17 R49	RES,C,1/4W,5%,1M	CF1/4-1M	ASE	4700-15-1004	2.000
R22 R42 R44	POT,20K,RP130-320	89PR20K	BEK	4610-00-2203	3.000
R23	RES,C,1/4W,5%,360K	CF1/4-360K	ASE	4700-15-3603	1.000
R27 R29 R36	RES,C,1/4W,5%,100K	CF1/4-100K	ASE	4700-15-1003	3.000
R31	POT,250K,RP129-425	360S254B	CTS	4610-00-1254	1.000
R32	RES,C,1/2W,5%,390	CF1/2-390	ASE	4700-25-3900	1.000
R33 R35 R43 R46	RES,MF,1/8W,1%,178K	RN55D-178K	MILSP	4701-03-1783	4.000
R34 R45	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	2.000
R38	RES,C,1/4W,5%,51K	CF1/4-51K	ASE	4700-15-5102	1.000
R39	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R40	POT,10K,RP130-310	89PR10K	BEK	4610-00-2103	1.000
R47	RES,C,1/4W,5%,33K	CF1/4-33K	ASE	4700-15-3302	1.000
R48	RES,C,1/4W,10%,100M	CB1071	A-B	4700-16-1006	1.000
R50 R52	RES,C,1/8W,5%,100 RC101-110	CF1/8-100	ASE	4700-05-1000	2.000
R51	RES,C,1/8W,5%,68	CF1/8-68	ASE	4700-05-6809	1.000
R53	RES,C,1/4W,5%,22K	CF1/422K	ASE	4700-15-2202	1.000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	BASE,MKR FROM:3210-08-0039	A000-519	W-I	1410-00-0820	1.000
2	MKR. CHASSIS	A000-594	W-I	1410-00-1060	1.000
3	CAN,MKR FROM:3210-08-0038	A000-518	W-I	1410-00-0810	1.000
4	SCW,SBH,6-32X1/8	4030NP	F-S	2810-17-6102	2.000
5	CLOVERLEAF FTE-12 HT101-000	011-6808-000-59-9	SEL	2112-18-0001	8.000
C01	CAP,DISC,1KV,47PF	60U2J470J	MDC	1510-10-3470	1.000
C02 C08	CAP,DISC,1KV,20PF	60C0G200J	MDC	1510-10-0200	2.000
C03	CAP,DISC,1KV,100PF	60U101M	MDC	1510-10-1101	1.000
C04 C06 C07	CAP,FT,250V,500PF	4420-500PF	AER	1510-30-3501	3.000
C05	CAP,DISC,1KV,25PF	60C0G250J	MDC	1510-10-0250	1.000
C09	CAP,DISC,1KV,.001UF	5GAD10	SPR	1510-10-1102	1.000
C10	CAP,FT,500V,470PF	FA5C-4712	A-B	1510-30-0471	1.000
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2.000
L01	CHOKE,COATED,2.2UH	08N2R2	JEF	1810-03-0229	1.000
L02	COIL,10T FROM:1813-00-0001	1210-32-0009	W-I	1210-32-0009	1.000
Q01	TRANS QA038-541 2N3854A	2N3854A	G-E	4901-03-8541	1.000
Q02	TRANS QA051-790	2N5179	RCA	4901-05-1790	1.000
R01	RES,C,1/4W,5%,47K	CF1/4-47K	ASE	4700-15-4702	1.000
R02	RES,C,1/4W,5%,56	CF1/4-56	ASE	4700-15-5609	1.000
R03	RES,C,1/4W,5%,1.5K	CF1/4-1.5K	ASE	4700-15-1501	1.000
R04 R05	RES,C,1/4W,5%,1K	CF1/4-1K	ASE	4700-15-1001	2.000
R06	RES,C,1/4W,5%,10K	CF1/4-10K	ASE	4700-15-1002	1.000
T02	RF XFMR FROM:1813-00-0001	1210-42-0037	W-I	1210-42-0037	1.000
X01	CRYSTAL,XX000-331	X33W-00.00000	W-I	2310-00-0331	1.000

6.1 INTRODUCTION

This section contains all schematics for the instrument. A schematic index is given in paragraph 6.3.

6.2 SCHEMATIC NOTES

The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

All values are shown in the following units unless otherwise specified.

Components	Units
Resistor	ohms
Capacitor	picofarads
Inductor	microhenries

Denotes DC voltage reading in volts unless otherwise specified.

Denotes high impedance crystal detector reading in volts unless otherwise specified.

Denotes 50 ohm crystal detector reading in volts unless otherwise specified.

Signal or voltage source.

Connects to indicated signal or voltage source.

Arrow indicates clockwise rotation of wiper.

Coaxial jack

Coaxial plug

Coaxial cable

Factory adjusted part.

Denotes a front-panel device.

Denotes a rear-panel device.

Denotes a PC board adjustment or accessible module adjustment.

Denotes an internal module adjustment not accessible without removing module cover.

GENERAL

A	ampere	DC	direct current	Ω	ohm
AC	alternating current	DS	indicating device, lamp	pp	peak-to-peak
CW	continuous wave	F	farad	RF	radio frequency
cw	clockwise	F.P.	front panel	RMS	root-mean-square
ccw	counterclockwise	H	henry	R.P.	rear panel
dB	decibel	Har	harmonic	TP	test point
dBm	decibel referred to 1 mW	Hz	hertz	V	volt
dBmV	decibel referred to 1 mV	IF	intermediate frequency	VA	voltampere
				W	watt

SCHEMATIC REFERENCES

A	assembly	K	relay	R	resistor
C	capacitor	L	inductor	S	switch
CR	diode	M	meter	T	transformer
F	fuse	OC	opto-coupler	V	vacuum tube
IC	integrated circuit	P	plug	X	crystal
J	jack	Q	transistor	W	cable assy.

SCIENTIFIC PREFIXES

G = giga (10^9)	k = kilo (10^3)	m = milli (10^{-3})
M = mega (10^6)	c = centi (10^2)	μ = micro (10^{-6})
		p = pico (10^{-12})

6.3 SCHEMATIC INDEX

The schematics appear in the following order.

ASSEMBLY	NAME
1405	**Wiring Diagram**
PS7	**Power Supply**
M2E-3	**Sweep Drive**
M6C	**External Marker**
M6P	**Additional RF Markers**
M6S	**Single Frequency Marker**
M7E	**L.O. Tracking Marker**
M8E-1 & 2	**Auto Level**
M13J-2	**IF Pulse Markers**
SPM183B	**2nd L.O. Tracking Marker**
M202	**Block Diagram**
M202	**Pulse Marker/SS Leveler**
SPM279	**CW Source**
SPM656	**Sweep Oscillator/Amp**
SP636	**Programmer Wiring Diagram**
SP636	**Counter Display Driver**
SP636	**Memory Card**
SP636	**Frequency Control Card**
SPM636	**Phase Lock Module**

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

SWEEP SAMPLE OUT
J2
CW IN
J3
VHF SWEEP
J1
C1 .05μF
CR1
CR2
L1 10T
L2 10T
R1 51
R2 51
CR3
R4 220
R3 100
C5 500
L2 1μF
+18
-18
R5 18K
R6 1K
IC1 741
R7 100
C4 1μF
R8 47K
R9 470K
R10 270K
R11 20K LEVEL
C3 6.8
R44 68
R46 130
R45 68
CM1
C7 4.7
C8 10
L3
C6 180
R12 4.7K
R41 22K
R43 22K
C34 .025μF
C35 .05μF
C36 6.8
PULSE OUT TO PROGRAMMER
Q9 2N3854A
Q10 2N3854A
R42 1K
R40 10K
C33 2000
C9 6.8
TO SLAVE
C10 6.8
T.P.
C11 .01μF
R13 1K
L4
R14 10K
C14 180
R16 47K
R39 1K
C16 .005μF
R19 2.2K
C18 470
R21 12K
R23 1K
R25 270K
R27 1K
R28 47K
R32 22K
R35 22K
R37 22K
C25 .025μF
C27 .05μF
C28 6.8
PULSE OUT
C23 2000
Q6 2N3854A
Q8 2N3854A
C24 .002μF
Q7 2N3854A
Q2 2N3854A
Q3 2N3854A
CR4
C19 470
R24 10K
R26 100K
C21 .005μF
C20 20
Q5 2N5306
R34 10K
R38 2.2K
C29 6.8
PULSE TRIGGER IN
C26 .05μF
Q1 40841
C15 200
R17 47K
R18 10K
R15 220
C13 .01μF
C12 .01μF
C17 .005μF
R20 4.7K
R22 47K
IC2 N5741V
CR5
R33 10K
R36 1K
R30 220K
R31 10M
R29 4.7K
C22 .47μF
C30 10μF
C31 470
C32 470
-18V
+18V

LAST REF. DES. USED	
C 36	L 4
R 46	S
Q 10	P
IC 2	J 3
CR 5	X
T	F

NEXT ASSY | USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS ±1/64 DECIMALS XX ± .01 XXX ± .005 ANGLES ±30
MATERIAL CHASSIS * 1416-20-0021
FINISH ASSY * 1114-43-0009
DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN DJ WATSON	2-7-83
CHECKED	
RELEASED	

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WAVETEK INDIANA, INC.

M202
PULSE MARKER/
SWEEP SAMPLE LEVELER

SIZE	CODE IDENT NO	DRAWING NO
C	34280	0614-30-0031

SCALE | SHEET OF

MARBAUGH

REVISIONS

ZONE	LTR	DESCRIPTION	DATE	APPROVED

REMOTE PLUG
TO PROGRAMMER
J101
REMOTE JACK
+18
-18
M6P
TO PROG.
M2A2
PULSE MKR/ SS LEVELER
PULL NAR
P2 91K
R1 10K
SWEEP WIDTH
R3 10K
FREQ
M2E-1
SWEEP DRIVE
SPM656
1-500 MHz
STEP ATTN 7535-01
FRONT PANEL
RF
A1
A1
A1 OR A3
SPM183B
BASELINE 2ND L.O. TRACKING MKRS
PROGRAMMER OR FRONT PANEL SELECT
S1
R4 10K
Δ-20dB VERN ATTN
S2
AUTO LEVEL
IF IN
REAR PANEL
EXT MARKER IN
CW OUT
PULSE MARKERS OUT
TO P.S.
M7E
L.D. TRACKING MARKER
M8E
AUTO LEVEL
DEMOD IN
SCOPE VERT
HORIZ.
M13J-2
IF PULSE MARKERS
L1 10
L2 10
R5 10K
MKR SIZE
PULL SMALL
R6 91K
SP426 SPM279
X-TAL CW SOURCE
SP426 SPM279
X-TAL CW SOURCE
CW SOURCE
CW SOURCE
IF MARKERS
2nd L.O. MKR
2nd L.O. MKR
2nd L.O. MKR OR EXT MKR
S3 F.P.
POWER
S101
NC
P1
TO POWER SUPPLY J1
-30V
+18V
-18V
-5 TO +15V
-8V TO +8V
TO PULSE MKRS AMP
N/C REMAINING PINS
J2
TO POWER SUPPLY P2
R7 1.5K

MARBAUGH

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
DO NOT SCALE DRAWING
CONTRACT NO
APPROVALS DATE
DRAWN D. J. WATSON 7/10/85
CHECKED
RELEASED

WAVETEK INDIANA, INC

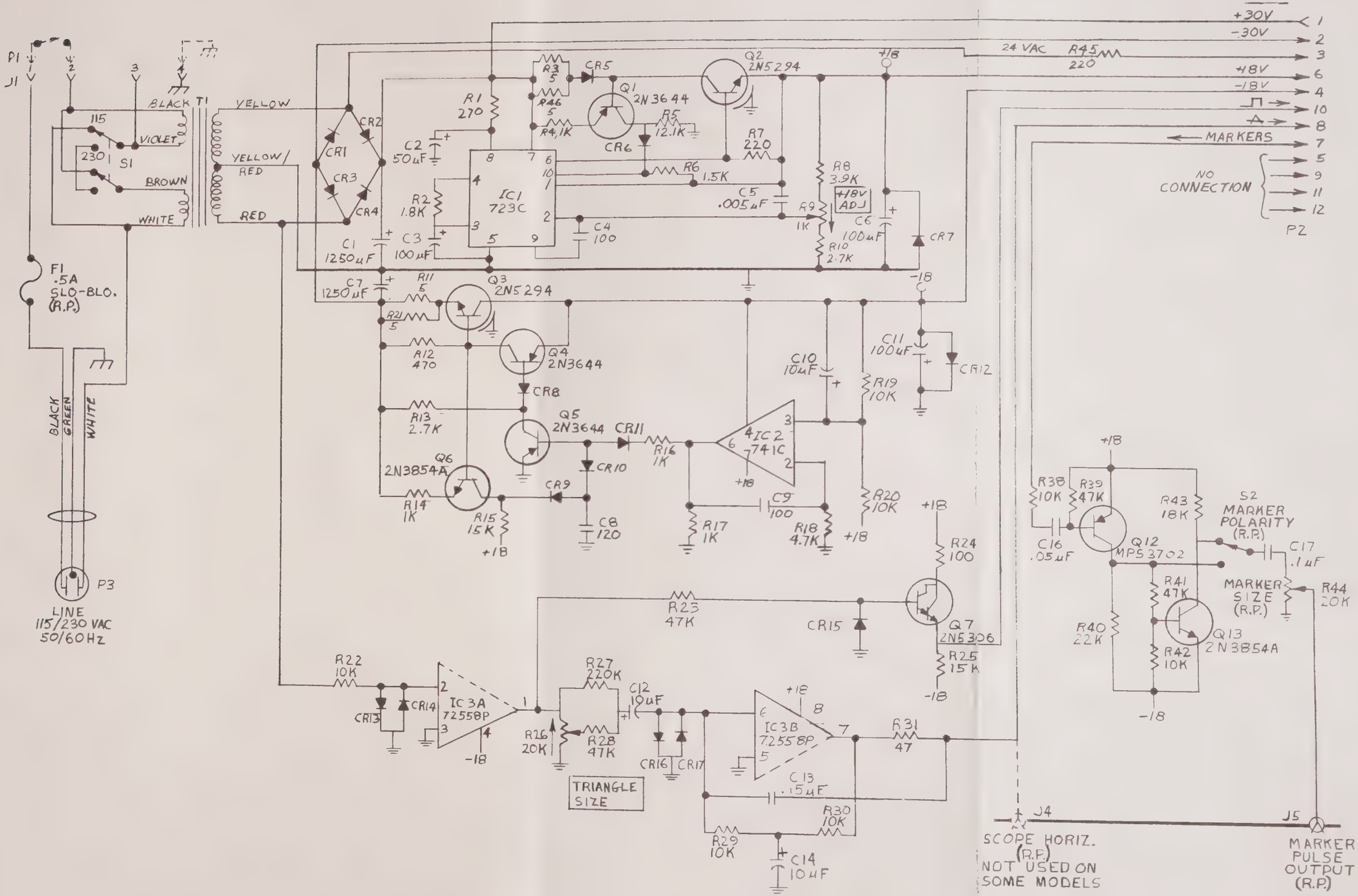
1405 WIRING DIAGRAM

SIZE D | CODE IDENT NO 34280 | DRAWING NO A1619-40-LDC4

SCALE | SHEET 1 OF 1

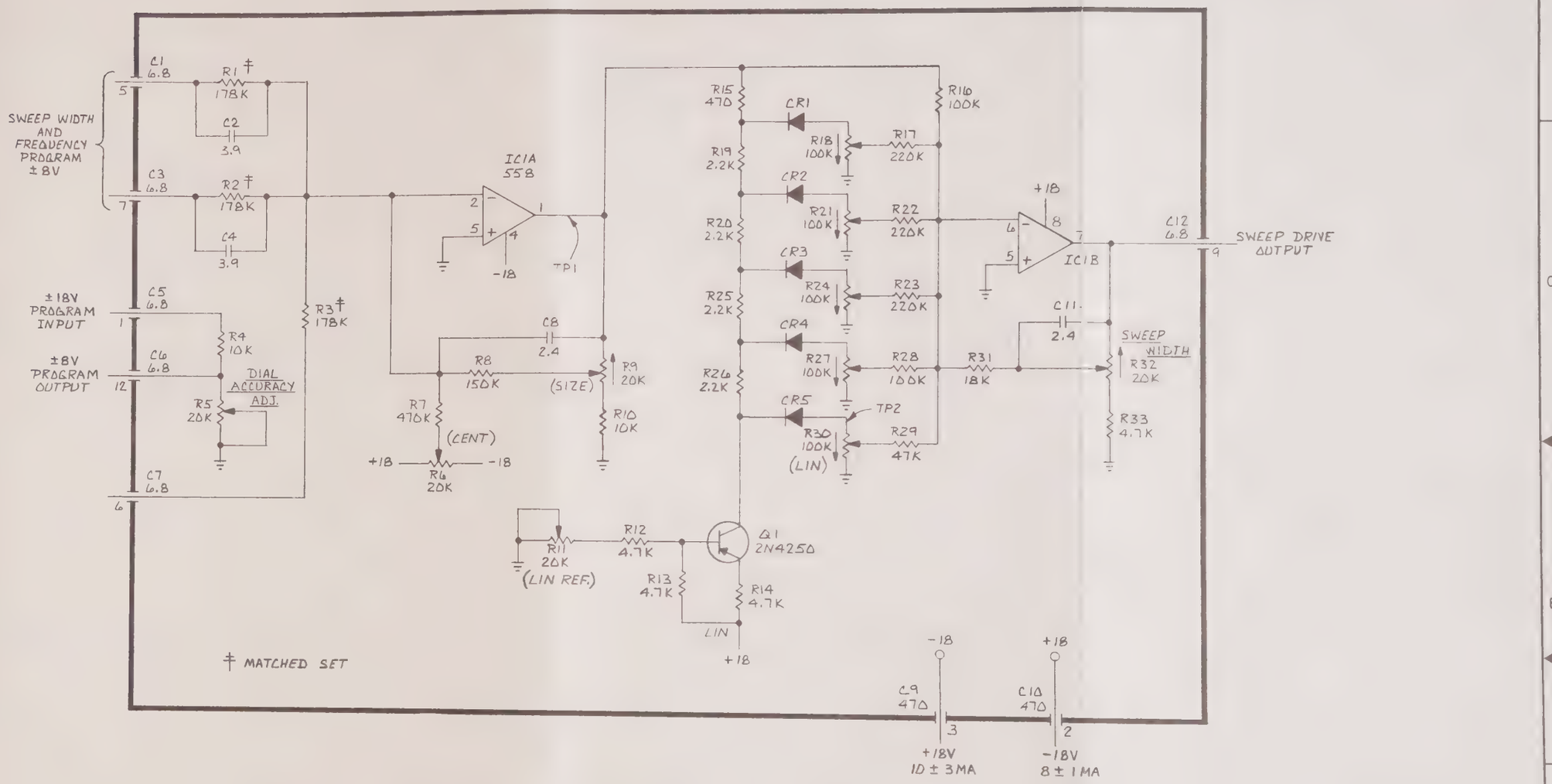
PS7
POWER SUPPLY

REV. D



REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED

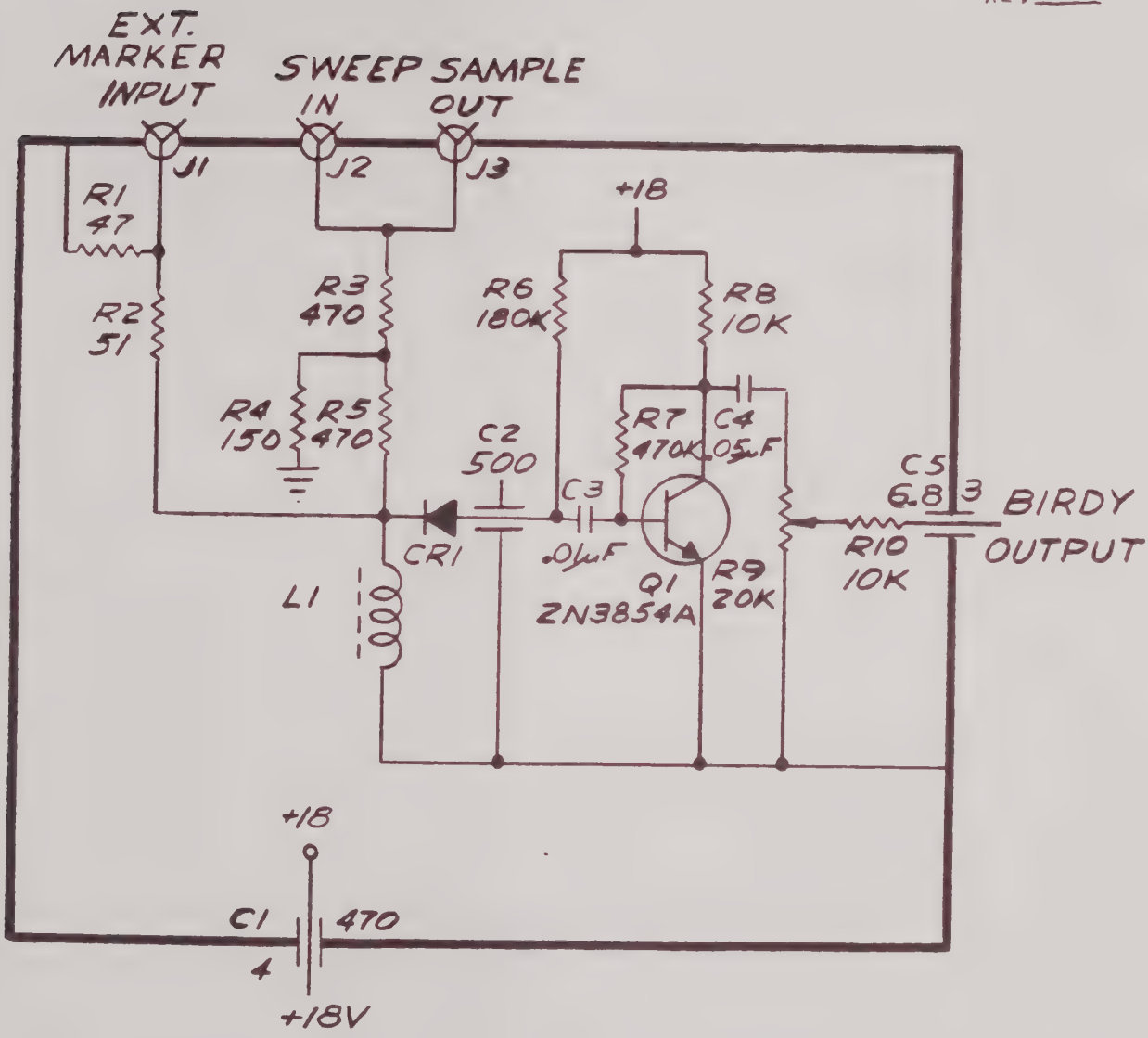


NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES ±1/64 XX ± 01 ±30' XXX ± 005	CONTRACT NO.	WAVETEK INDIANA, INC	
APPLICATION		MATERIAL	APPROVALS / DRAWN DJWATSON	DATE 1-25-84	M2E-3 SWEEP DRIVE
		FINISH	CHECKED		
		DO NOT SCALE DRAWING	RELEASED		SIZE C · CODE IDENT NO 34280 · DRAWING NO. 3014-30-0045 · SCALE · SHEET 1 OF 1

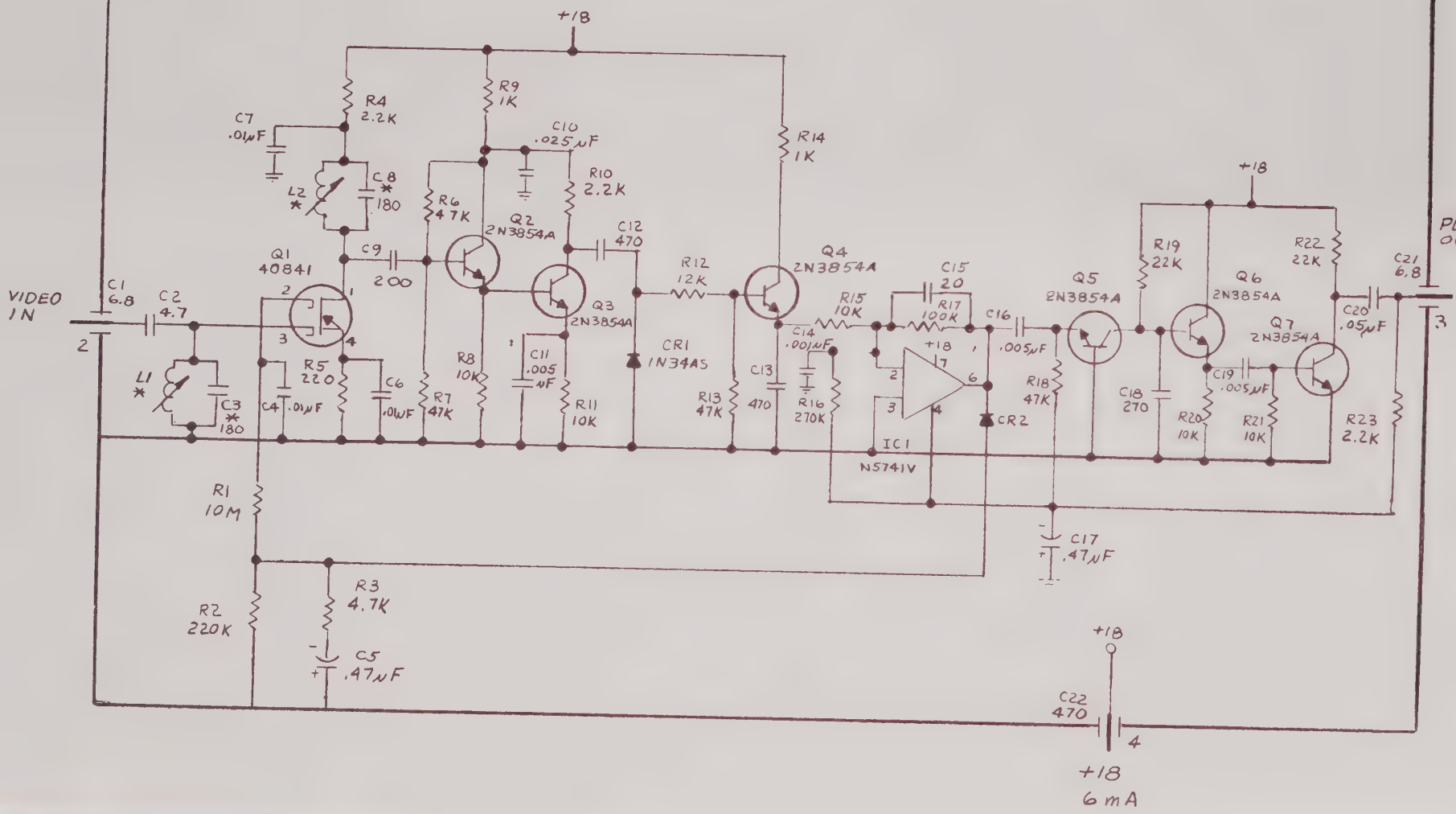
MARBAUGH

M6C
EXT. MARKER

REV A

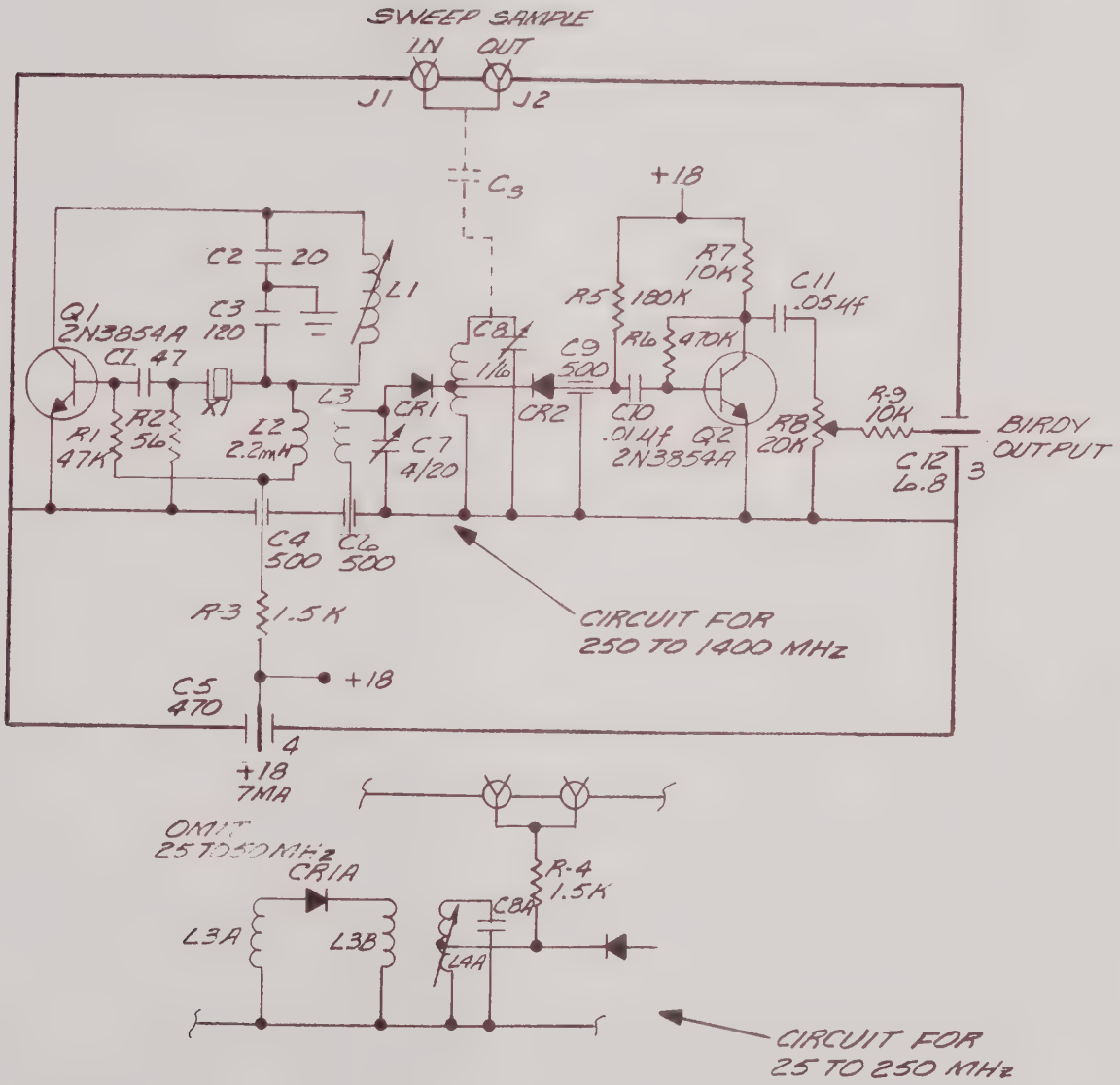


M6P
ADDITIONAL RF MARKERS



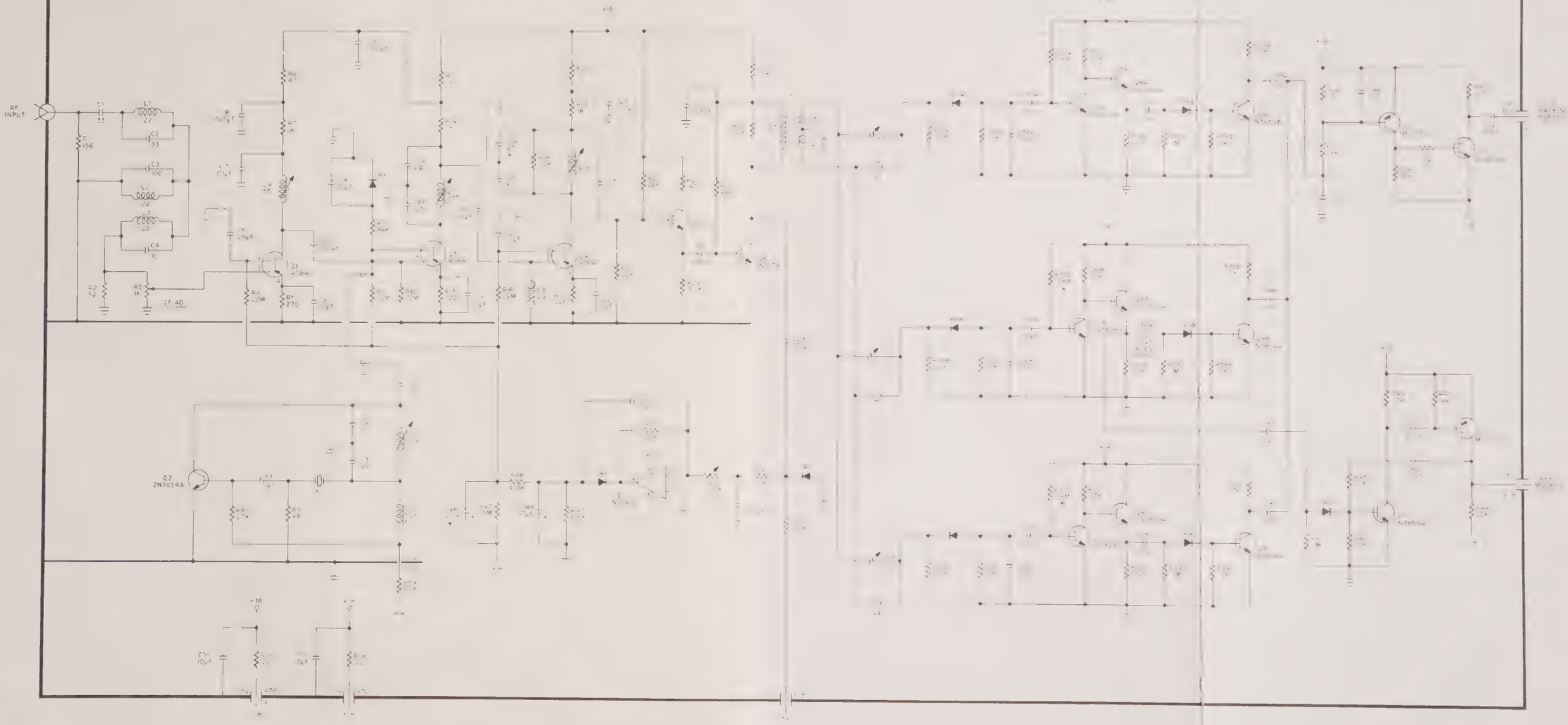
M6S
SINGLE FREQ MARKER

REV A



M7E
L.O. TRACKING MARKER

REV.



DEMOD INPUT
LEVEL PROGRAM
MARKER INPUT
TUNING PROGRAM
TRACE RETRACE
POLARITY
DEMOD OUTPUT
AUTO LEVEL OUTPUT
HOLD
VAR. GAIN
RANGE
CENTERING
THESE PARTS ONLY USED ON M8E-2
IC3A 4558
IC3B
IC4A 4558
IC4B
IC5A 4558
IC5B
IC6A TL082
IC6B
IC2A TL082
IC2B
IC7A TL082
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
Q1 2N3904
Q2 2N5458
Q3 2N5458
Q4 2N5458
Q5 2N5458
Q6 2N5458
Q7 2N5458
Q8 2N3702
Q9 2N3702
Q10 2N3644
Q11 2N3904
-18
+18
-30
-18
+18
7mA
33mA
40mA

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

LAST REF. DES. USED	
C 38	L
R 77	S 2
Q 11	P
IC 7	J
CR 8	X
T	F

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS±1/64 DECIMALS .XX ±.01 .XXX ±.005 ANGLES ±30
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
DO NOT SCALE DRAWING
CONTRACT NO
APPROVALS
DATE
DRAWN D.J. WATSON 3-1-83
CHECKED
RELEASED
THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO WAVETEK. IT IS TO BE USED ONLY FOR THE EQUIPMENT AND MAY NOT BE REPRODUCED WITHOUT PRIOR APPROVAL IN WRITING OF WAVETEK

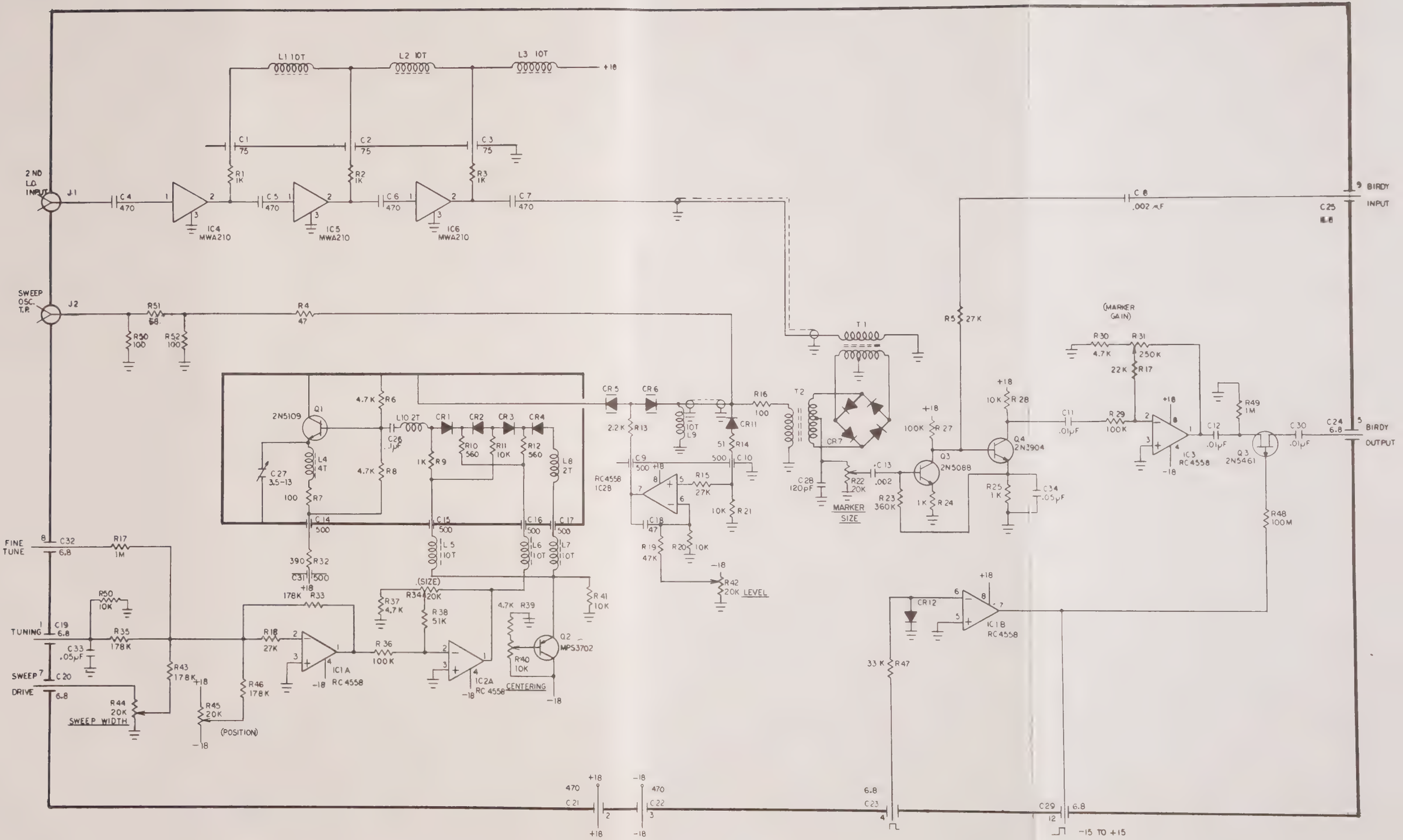
WAVETEK INDIANA, INC
M8E-1 & 2
SIZE D
CODE IDENT NO 34280
DRAWING NO D619-40-D007
SCALE
SHEET OF

MARBAUGH

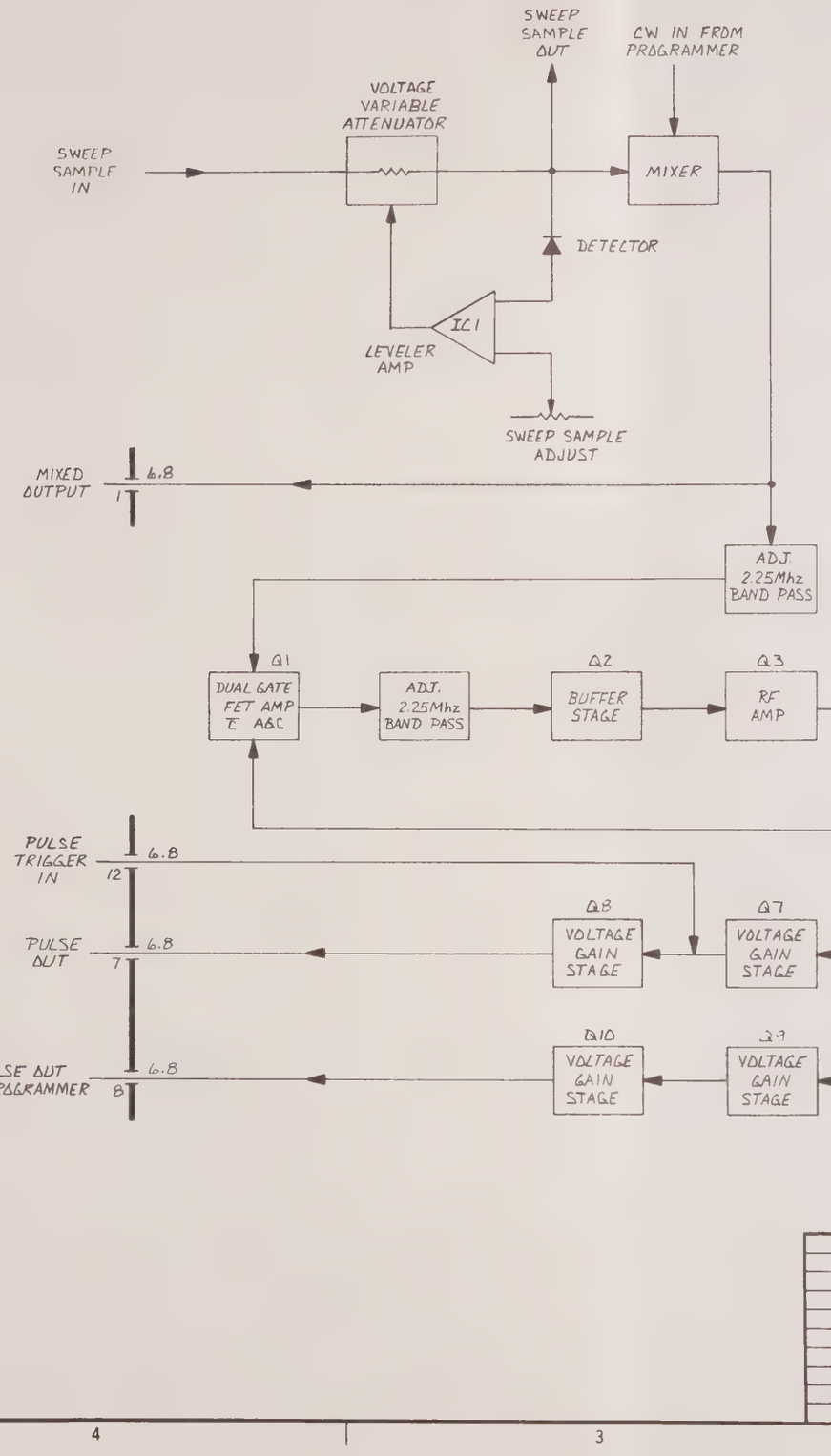
M13J-2
IF PULSE MARKERS REV. ___

SWEEP SAMPLE IN
J1
R4 56
SWEEP SAMPLE ADJUST
R1 1K
C1 .001μF
R44 2.7K
C23 120
R45 820
R46 10
Q9 2N5053
Q1 2N5053
+18
R3 1K
C22 .05μF
R43 3.3K
R2 47K
T1
4T
2T
2T
X1
C3 3.5/13
R5 1K
CR1
C8 .001μF
X2
C4 3.5/13
R6 1K
CR2
C9 .001μF
X3
C5 3.5/13
R7 1K
CR3
C10 .001μF
X4
C6 3.5/13
R8 1K
CR4
C11 .001μF
R41 5.6K
X5
C7 3.5/13
R9 1K
CR5
C12 .001μF
R42 5.6K
R16 1.5M
CR6
IC3B 1458
-18
CR7
R37 1M*
R15 10K
C13 6.8
R10 270
R11 270
R12 270
R13 270
R14 270
IC 1458
R22 5.1K
R23 5.1K
R24 5.1K
R25 5.1K
R26 5.1K
Q4 MPS3702
Q5 MPS3702
Q6 MPS3702
R27 22K
C16 200
R28 22K
C17 200
R29 22K
C18 200
+18
R35 22K
C19 .05μF
Q8 2N3904
CR13
C29 6.8
PULSE MARKERS OUT
B+ FOR IF MKRS:
C24 1000
C20 470
C21 470
-18
+18

SPM 183B
2ND L.O. TRACKING
MARKER



REVISIONS				
		DESCRIPTION	DATE	APPROVED



NEXT ASSY	USED ON	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS ±1/64 DECIMALS XX ± .01 XXX ± .005 ANGLES ±30	CONTRACT NO	WAVETEK INDIANA, INC
APPLICATION		DO NOT SCALE DRAWING	APPROVALS / DATE: DRAWN D J WATSON 2-10-83; CHECKED; RELEASED	M202 BLOCK DIAGRAM
		MATERIAL; FINISH		SIZE C · CODE IDENT NO 34280 · DRAWING NO 0619-30-0002
				SCALE · SHEET 1 OF 1

MARBAUGH

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

SWEEP SAMPLE OUT
J2
CW IN
J3
VHF SWEEP
J1
C1 .05μF
CR1
CR2
L1 10T
L2 10T
R1 51
R2 51
CR3
R4 220
+18
R3 100
C2 1μF
C5 500
R5 10K
-18
R10 270K
R11 20K LEVEL
R6 1K
IC1 741
R9 470K
R7 100
C4 1μF
R8 47K
C3 6.8
-18
C7 4.7
L3
C6 180
C8 10
CM1
R12 4.7K
R44 68
R46 130
R45 68
+18
R41 22K
R43 22K
C34 .015μF
C35 .05μF
C36 6.8
PULSE OUT TO PROGRAMMER
Q1 2N3854A
Q10 2N3854A
R42 1K
R40 10K
L33 2000
C9 6.8
TO SLAVE
C10 6.8
T.P.
C11 .01μF
R13 1K
L4
R14 10K
C14 180
R16 47K
R39 1K
C16 .005μF
R19 2.2K
C18 470
R21 12K
R23 1K
+18
-18
R25 270K
R27 1K
-18
R28 47K
R32 22K
Q6 2N3854A
R35 22K
C25 .025μF
Q8 2N3854A
R37 22K
C27 .05μF
C28 6.8
PULSE OUT
C23 2000
C15 200
Q2 2N3854A
Q4 2N3854A
R24 10K
R26 100K
C21 .005μF
C24 .002μF
Q7 2N3854A
-18
R38 22K
Q1 40841
Q3 2N3854A
CR4
C19 470
+18
C20 20
Q5 2N5306
C26 .05μF
C29 6.8
PULSE TRIGGER IN
R17 47K
R18 10K
R15 220
C13 .01μF
C12 .01μF
C17 .005μF
R20 4.7K
R22 47K
CR5
IC2 N5741V
-18
R33 10K
R34 10K
R36 1K
+18
C30 10μF
R30 220K
R31 10M
R29 4.7K
C22 .47μF
-18
L31 470
C32 470
+18V
-18V

LAST REF. DES. USED		
C 36	L 4	
R 46	S	
Q 10	P	
IC 2	J 3	
CR 5	X	
T	F	

NEXT ASSY | USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
±1/64 XX ± .01 ± 30
XXX ± .005
MATERIAL CHASSIS *
1416-20-0021
FINISH ASSY *
1114-63-0009
DO NOT SCALE DRAWING

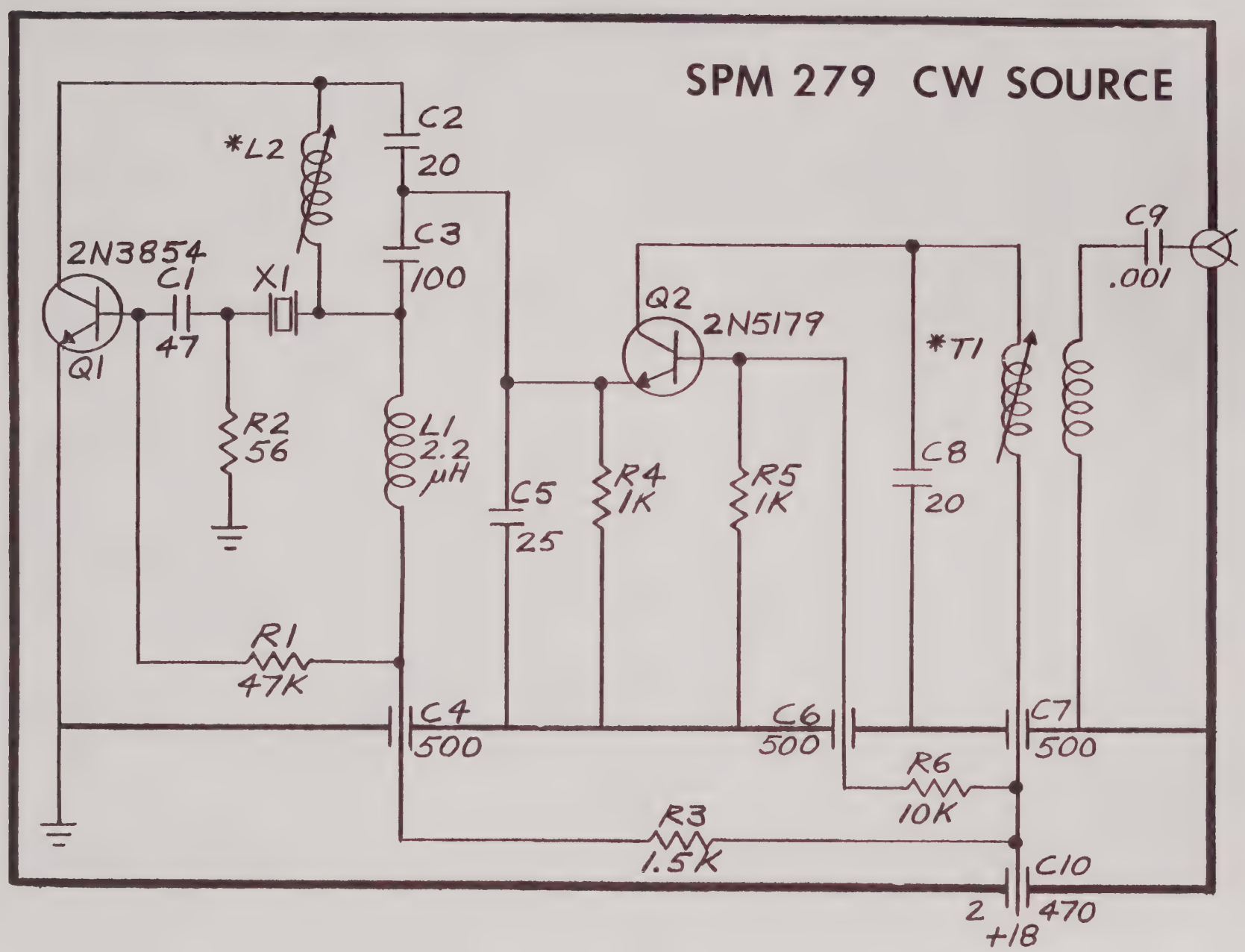
CONTRACT NO
APPROVALS | DATE
DRAWN DJ WATSON 2-7-83
CHECKED
RELEASED

WAVETEK INDIANA, INC

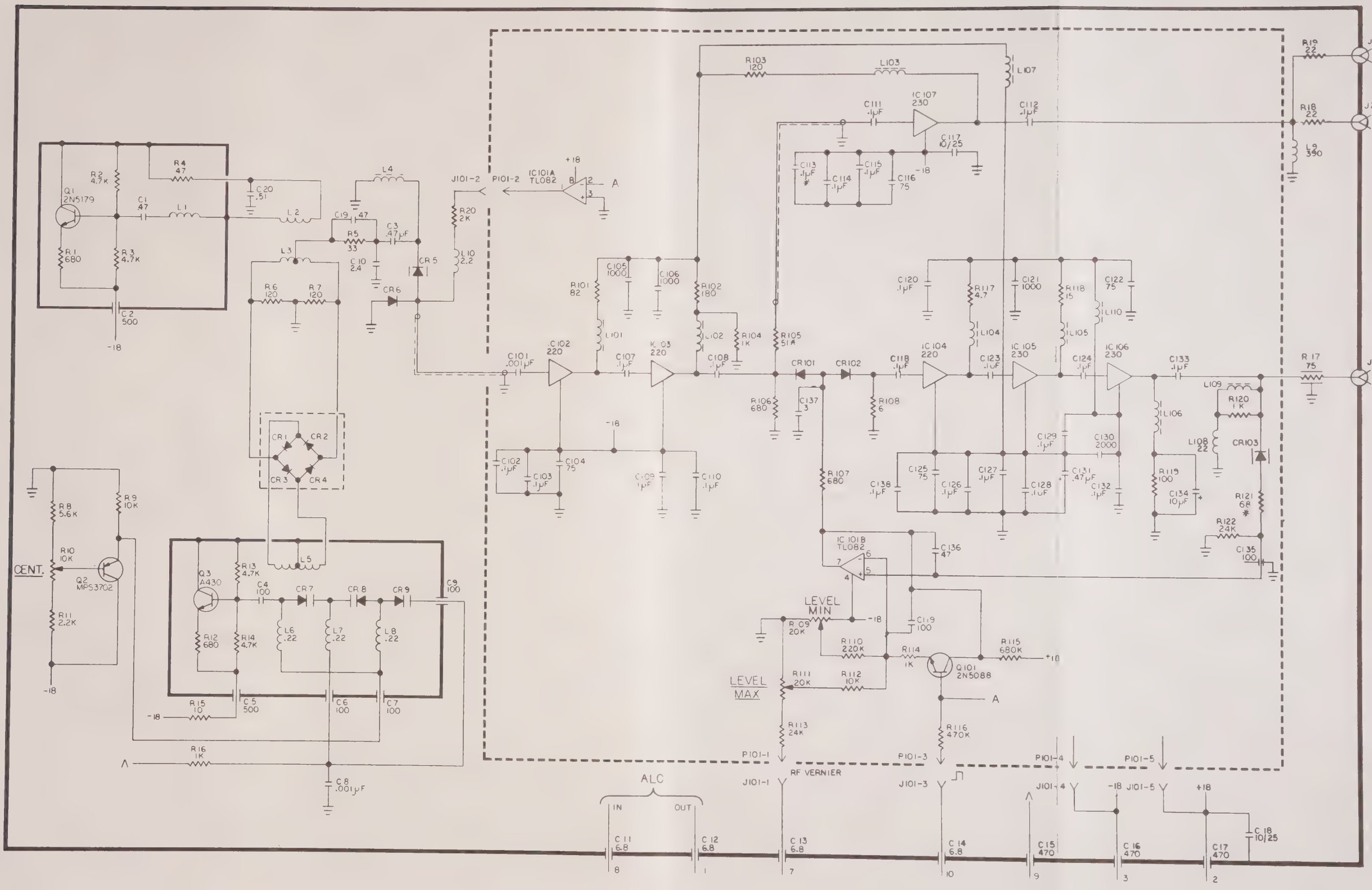
M202
PULSE MARKER/
SWEEP SAMPLE LEVELER

SIZE C | CODE IDENT NO 34280 | DRAWING NO 0614-30-0031
SCALE | SHEET OF

MARBAUGH


SPM 279 CW SOURCE
*L2
C2
20
C3
100
2N3854
C1
47
X1
Q1
R2
56
L1
2.2
μH
C5
25
R4
1K
Q2
2N5179
R5
1K
*T1
C8
20
C9
.001
R1
47K
C4
500
C6
500
C7
500
R6
10K
R3
1.5K
C10
2
+18
470

SPM 656
SWEEP OSCILLATOR / AMPLIFIER



ZONE	LTR	DESCRIPTION	DATE	APPROVED

COUNTER DISPLAY DRIVER CARD

MEMORY CARD

FREQ. CONTROL CARD

P1

P2

P3

FRONT PANEL

J104 P104 P4 J4

1 ↔ 1
2 ↔ 2
3 ↔ 3
4 ↔ 4
5 ↔ 5 — NC
6 ↔ 6
7 ↔ 7
8 ↔ 8
9 ↔ 9
10 ↔ 10
11 ↔ 11
12 ↔ 12
13 ↔ 13
14 ↔ 14

J105 P105 P5 J5

1 ↔ 1
2 ↔ 2
3 ↔ 3
4 ↔ 4
5 ↔ 5
6 ↔ 6
7 ↔ 7
8 ↔ 8
9 ↔ 9
10 ↔ 10
11 ↔ 11
12 ↔ 12
13 ↔ 13
14 ↔ 14

J8
1 2 3
P8
+5 GND +18
IC1
LM340T
(-12)

J9
1 2 3
P9
+5 GND +12
IC2
78M05

GND
+18
-18
TUNING

J11 P11

1 NC
2
3 — FOOT PEDAL
4 NC
5
6 — FOOT PEDAL

(IN 1907A)

J12 P12 P101 J101

GND
+18
-18
9 ↔ 3 — TUNING
5 ↔ 9 — PULSE OUT
6 ↔ 7
11
10
5
6
13
14

P7 J7

1
2
3
6
11 — NC
12
13
14 — NC

LF 3w
PHASE LOCK

RF IN

TP

A18

RF OUT

SP656
0-500 MHz OSC.

SS A1 — TO M202

NEXT ASSY	USED ON			
APPLICATION				

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
±1/64 .XX ± .01 ±30
.XXX ± .005

MATERIAL
A/R
1015 1/4 THK

FINISH
BOARD

DO NOT SCALE DRAWING

CONTRACT NO

APPROVALS	DATE
DRAWN DJ WATSON	1-31-85
CHECKED	
RELEASED	

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WAVETEK INDIANA INC

SP636
[illegible]

SIZE	CODE IDENT NO	DRAWING NO
D	34280	D1019-40-0003

SCALE — SHEET 1 OF 1

MARBAUGH

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

IC1 CD4011BE
IC2 CD4011BE
IC3 CD4002
IC4 MC14029
IC5 MC14029
IC6 MC14029
IC7 MC14029
IC8 CD4013
IC9 CD40109
IC10 CD40109
IC11 CD40109
IC13 CD4511
IC15 MC14011
IC19 CD4541

R1 10K
R2 10K
R3 10K
R4 10K
R5 10K
R6 10K
R7 47K
R8 100K
R9 100K

C1 1μF
C2 1μF
C3 1μF
C4 1μF
C5 1μF
C6 1μF
C7 10μF
C8 1μF
C9 1μF
C10 1μF
C11 1μF
C12 1μF
C13 1μF
C14 1μF
C15 1μF
C16 .01μF
C17 2000

+5
+12

J101

39	RESET NO
41	RESET NC
45	SELECT NO
43	SELECT NC
47	U/D NO
49	U/D NC
34	DN
36	UP
26	c
8	d
30	e
22	b
24	a
24	g
28	f
	TENS
17	+12
21	+5
19	
2	e
4	d
6	c
8	b
10	a
12	g
14	f
	ONES
1	A_0 LSB
3	A_1
5	A_2 COUNT
7	A_3 CODE
9	A_4
11	A_5
33	A_6 MSB
13	MEMORY RESET

LAST REF. DES. USED	
C 17	L
R 9	S
Q	P
IC 15	J 101
CR	X
T	F

WAVETEK INDIANA INC

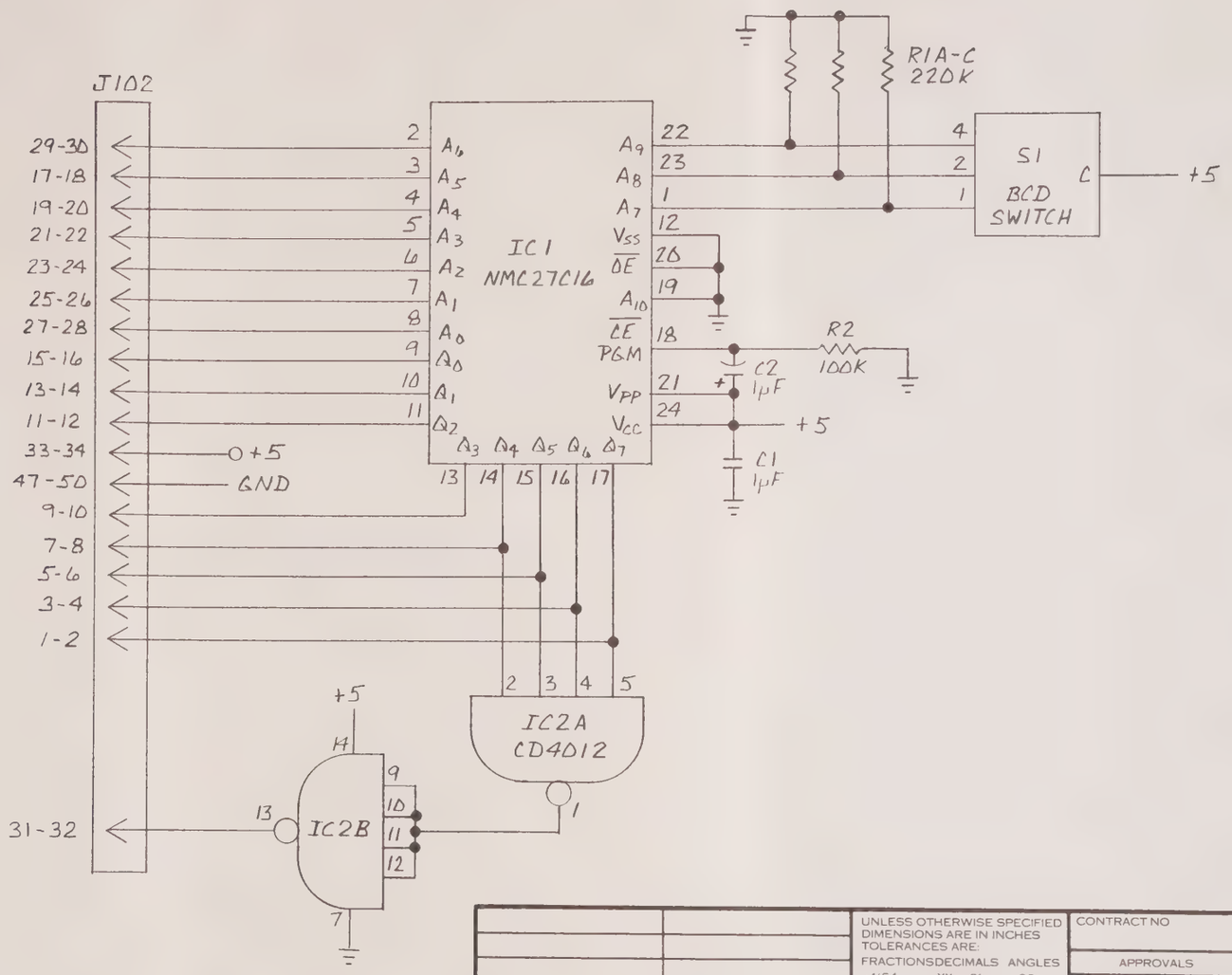
SP1636
COUNTER DISPLAY DRIVER

SIZE	CODE IDENT NO	DRAWING NO
D	34280	No14 90-0005

SCALE | SHEET 1 OF 1

MARBAUGH

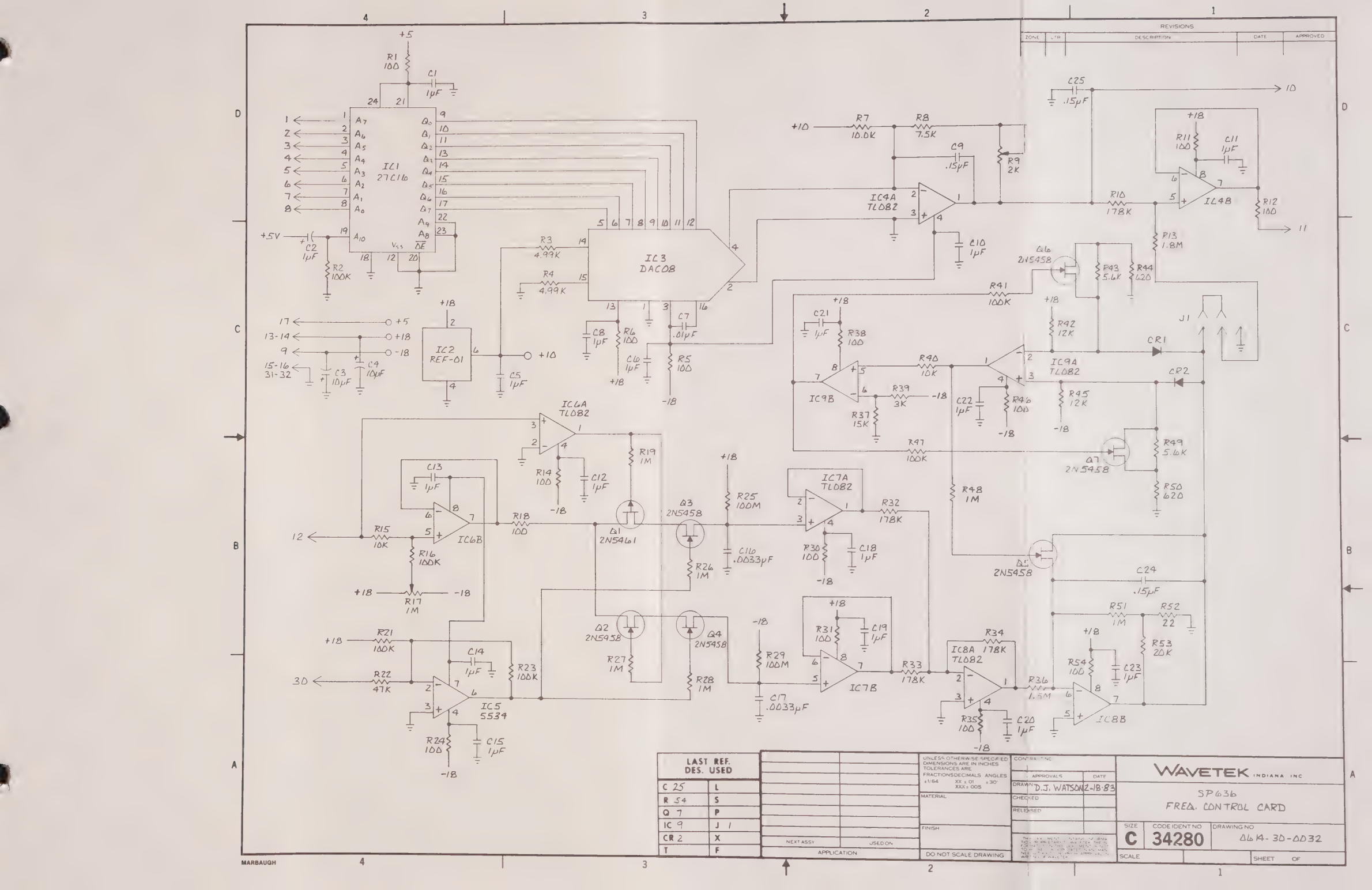
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

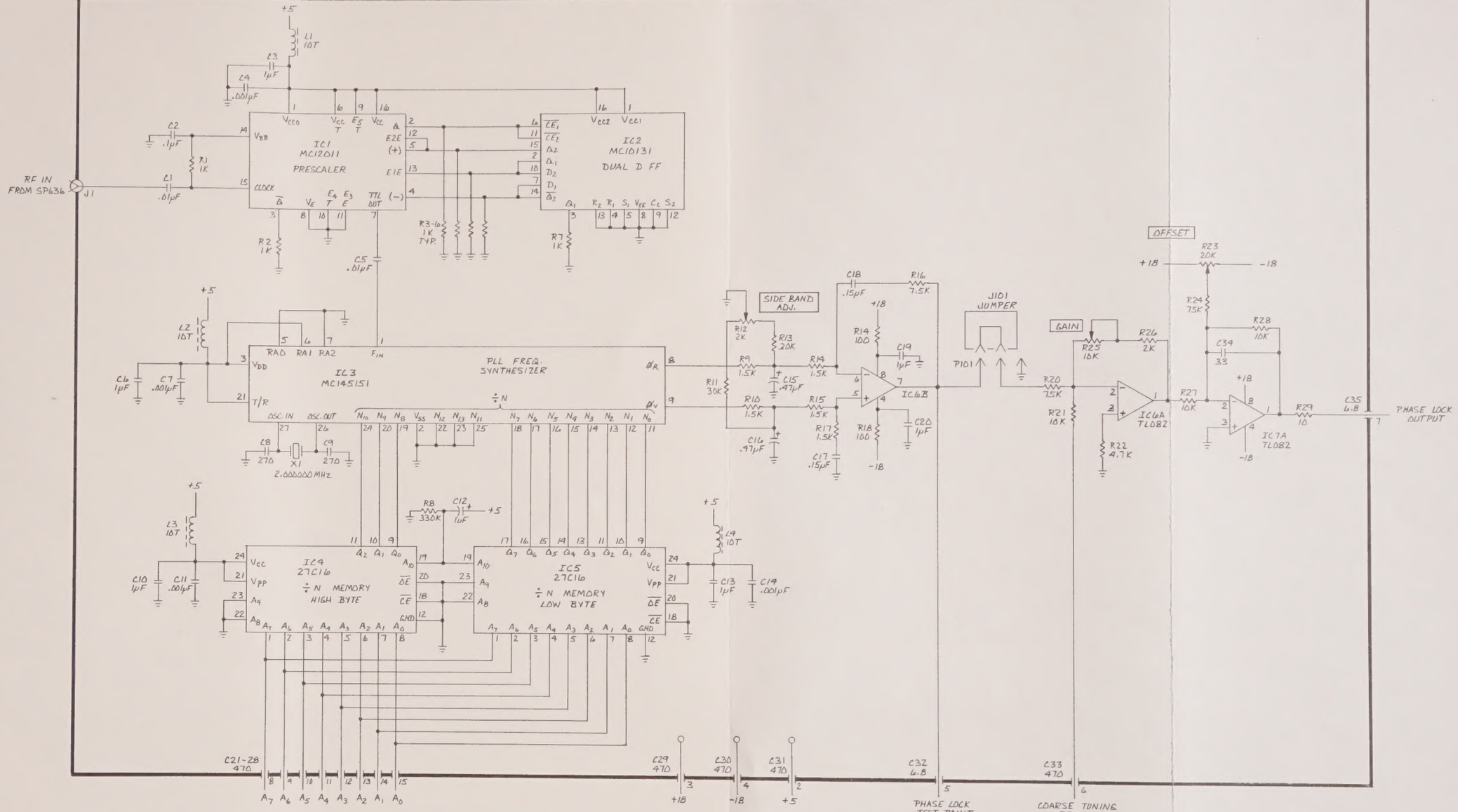


LAST REF. DES. USED	
C 2	L
R 2	S 1
Q	P
IC 2	J 102
CR	X
T	F

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ±1/64 DECIMALS .XX ±.01 XXX±.005 ANGLES ±30'	CONTRACT NO	WAVETEK INDIANA, INC
			APPROVALS / DATE	
			DRAWN DJ WATSON 1-24-83	SP636 MEMORY CARD
		BOARD # 1716-30-0033	CHECKED	
			RELEASED	SIZE B · CODE IDENT NO 34280 · DRAWING NO 0614-20-0003
	SP636	ASSY # 1110-63-0033		SCALE · SHEET 1 OF 1
NEXT ASSY	USED ON	DO NOT SCALE DRAWING	THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO WAVETEK. THE INFORMATION IN THIS DOCUMENT IS NOT TO BE USED OR DUPLICATED IN ANY MANNER WITHOUT THE PRIOR APPROVAL IN WRITING OF WAVETEK.	
APPLICATION				

MARBAUGH


REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
IC1 27C16
IC2 REF-01
IC3 DAC08
IC4A TL082
IC4B
IC5 5534
IC6A TL082
IC6B
IC7A TL082
IC7B
IC8A TL082
IC8B
IC9A TL082
IC9B
Q1 2N5461
Q2 2N5458
Q3 2N5458
Q4 2N5458
Q5 2N5458
Q6 2N5458
Q7 2N5458
CR1
CR2
J1
LAST REF. DES. USED
C 25 | L
R 54 | S
Q 7 | P
IC 9 | J 1
CR 2 | X
T | F
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE
FRACTIONS DECIMALS ANGLES
±1/64 XX ± 01 ± 30'
XXX ± 005
MATERIAL
FINISH
NEXT ASSY
USED ON
APPLICATION
DO NOT SCALE DRAWING
CONFIDENTIAL
APPROVALS DATE
DRAWN D.J. WATSON 2-18-83
CHECKED
RELEASED
WAVETEK INDIANA INC
SP636
FREQ. CONTROL CARD
SIZE C
CODE IDENT NO 34280
DRAWING NO 0614-30-0032
SCALE
SHEET OF
MARBAUGH



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

LAST REF. DES. USED		
C	35	L
R	29	S
Q		P 101
IC	7	J 101
CR		X 1
T		F

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ±1/64 .XX ± .01 .XXX ± .005

MATERIAL

FINISH

NEXT ASSY USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN D.J. WATSON	2-23-83
CHECKED	
RELEASED	

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WAVETEK INDIANA, INC.

SPM636
PHASE LOCKED
CW SOURCE

SIZE	CODE IDENT NO.	DRAWING NO.
D	34280	0161-40-0006

SCALE

SHEET 1 OF 1

MARBAUGH